In this Issue
THE TRUTH ABOUT OUR WARPLANES

OCT. 1942

AVIATION

The Oldest American Aeronautical Magazine

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NUMBER 10 VOLUME 42

OCTOBER, 1942

REGULAR EDITION

Contents

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Don Fink. *Special Assignment*

In This Issue 5
Editorial Page 91
The Truth About Our Fighter Planes 93
The Truth About Our Bombers 96
AVIATION'S War Communique No. 10 98
Profit Limitations by Treasury Directive — Selig Altschul 100
Meteorological Characteristics of Thunderstorms — George N. Brancato 101
The How and Why of Camouflage — Harper Goff 104

Aviation Manufacturing
Production—Design—Research—Engineering — Complete Index 107
Prefabricating Aircraft Parts at Reynolds — W. G. Reynolds and David P. Reynolds 108
Relieving Tooling Bottlenecks with Plastics — Leonard Weiss 114
The Future of Water-Based Airplanes, V — Capt. Frank T. Courtney 122
The Vidal Process for Molded Structures — E. Eugene Miller 124
Testing Aircraft Cowl Fasteners — O. J. Poupitch 126
Drop Hammer Technique and Innovations — Chris J. Frey and Stanley S. Kogut 130
Harnessing the Stratosphere — Dwight Tenney 137
Review of Patents 148
AVIATION's Sketch Book of Design Detail 154
AVIATION's Engineering Date Book 161
Subcontractor's Section:
Subcontracting from Scratch — Eugene K. Grey 189

New Products
Information Tips on Timely Aviation Topics 166
Modern Machine Tools 167
Shop Equipment and Accessories 172

Military
Final Training for the Real Thing 203
Blimps Return to the War — R. G. Picinich, Jr. 207

Air Transport
How Much Passenger Traffic? — Edgar A. Van Deusen 215

Maintenance
Locating Ignition Trouble — Dr. H. N. Walker 211
Maintenance at the Front 212
Civilians Replacing AAF Mechanics 212

Flying Equipment
Focke-Wulf FW-190A3 233
New Ryan PT-25 235

Civil Operation and Training
On Patrol 229
Along the Apron 230

Side Slips 197
Aviation's Dividend Prospects — Selig Altschul 199

The Aviation News
National Aviation 249
Washington Windsock 253
Calling Names 254
Aviation Manufacturing 257
Assembly Lines 261
Transport Aviation 263
Aviation Abroad 267
Finance By Raymond Headley 271
Aviation People 273
Book Reviews 275

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★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ IN THIS ISSUE ★ ★

BASEBALL is America's national sport. Practically everyone can read a simple box score. Despite the fact that the sports pages are filled with interpretations, inside dope, and armchair strategy, baseball fans know that the real story about the teams' progress, ability and equipment lies fully, irrevocably, and simply, in the little box labeled "League Standings." For the air war, the box score consists of confirmed enemy losses versus our own.

We think it would be a pretty good idea if the people of America applied the same reading knowledge to accounts of the war in the air. Read the experts, dopesters, criticisers, armchair strategists, if you must, but don't forget that the real story lies in the box scores which appear in the official communiques.

A fair portion of this issue is devoted to setting forth the straight information about American warplanes. It is not necessary to reveal military secrets to answer critics, both well meaning and otherwise. The facts contained in the editor's forceful message (page 91), in "The Truth About Our Fighters Planes" (page 93), "The Truth About Our Bombers" (page 96), and the "War Communique" (page 98) should do much to balance the unfavorable picture the public has had so far.

Among other things, the editorial sets out to rectify the one circumstance that provides the critics with a certain immunity—a lack of understanding of what aeronautical development really is, and how we are second to none in this respect. This is fundamental information and no one should undertake to criticise our air forces without having at least this background knowledge well in hand.

To deliberately ignore these fundamentals is to deliberately misrepresent the facts of the case.

The editors of AVIATION did not have to resort to "dopester's" devices to prepare a convincing case for American warplanes in this issue. It was done by simply taking the *only authentic* accounts of our warplanes in action via official communiques and official observers' reports as made available to everyone. The real answer is provided in the box score.

Now, and in the future, AVIATION will publish the box scores each month as they become available. The first one appears on page 250.

The first of a two part series on a conclusive evaluation of thunderstorm characteristics appears on page 101. The duration, movement relative to gradient winds, and circulation patterns of thunderstorms is discussed in this part.

On page 104 is a complete discussion of new methods and materials employed in camouflage as a protection against enemy air attack. Concerted enemy offensives are preceded by thorough reconnaissance, and the principal function of the "architecture of concealment" is to defeat the purpose of enemy camera lenses.

Prefabricating aircraft parts at the source of aluminum sheet is releasing men, machines and plant space for aircraft assembly work, making available millions of pounds of aluminum, ordinarily tied up as scrap, for increased aircraft production, and considerably alleviating transportation requirements. How the Reynolds Metals Company is doing this job is described on page 108.

Although revolutionary in character, the development of plastic tools is a spectacular reality employed to excellent advantage at Brewster Aeronautical Corp. Using a plastic compound of amazing versatility which is cast cold and hardens at room temperature, Brewster is making dies, jigs and fixtures at less cost and in a fraction of the time required for similar metal tools. A description of the methods used begins on page 114.

The fifth in a series of articles on flying boat design (page 122) discusses the drawbacks of conventional hull design, analyzes the causes and effects of porpoising, and enters the little explored field of hydrofoils.

The Vidal Process for molding wood and other materials for aircraft construction is being employed widely by Vidal licensees throughout the nation. On page 124 AVIATION is pleased to present the first detailed technical description of this process.

On page 130 is an article on drop hammer methods and innovations containing a number of helpful suggestions for getting the most out of drop hammers in aircraft metal forming.

The story of how two young men with a fixed idea started on a shoestring to build up a substantial aviation subcontracting business appears in the Subcontracting Section beginning on page 189.

A thorough discussion of ignition systems, the causes of trouble and their correction is the leading story in the Maintenance Section on page 211.

By reviewing the growth characteristics and records of other forms of transportation, some valuable criteria can be established for estimating the future growth of domestic air traffic. This is discussed in the Air Transport Section beginning on page 215.



The Curtis 'Warhawk" is one of the fightingest planes on any war front. In 'The Truth About Our Fighter Planes," on page 93, it is pointed out that on the basis of the record, the oft-criticized P-40 series will stand up to any planes the enemy can put against them.

Coming

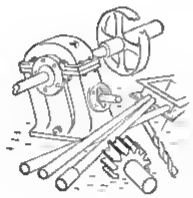
The concluding installment of the series of articles by Capt. Frank T. Courtney on flying boat design will appear in the November issue of Aviation. The author's conclusions and recommendations will be made after this thorough analysis of the lag in seaplane development to date.

Another important design series will start next month with Larry Marhoefer of the Vidal Research Corporation and one of the country's leading stress analysts presenting design criteria for molded aircraft structures.

WAR PRODUCTION

Won't Get the Steel it Needs

—UNLESS YOU TURN IN ALL YOUR SCRAP!



Your chips, borings, turnings, clippings, punched-out pieces, defective parts, and other scrap that you are turning back to the steel mills are going a long way to help win the war.

other items. It's in your plant or shop—or possibly on the junk heap behind it. There's some in the attic, basement or garage at home, too.

BUT THEY'RE NOT ENOUGH!

To make all the steel needed to keep war production plants up to schedule this year, more scrap iron and steel will be needed—6,000,000 *EXTRA* tons of it. About half of every ton of steel is scrap—whether it be open-hearth or electric furnace steel—the kind most needed for tanks, airplanes, ships, guns, shells.

There's plenty of scrap iron and steel—but it is not being turned back to steel producers. It's in the form of old machinery—broken and worn out dies, tools, jigs, templates, rolls, patterns, molds and fixtures—old gears, line shafting, pulleys, pipe, valves, radiators, water tanks, steel structures, trucks and dozens of

Unless *ALL* this scrap is turned in quickly, war production plants will not get the steel required to make the equipment needed to win the war.

TURN IN YOUR EXTRA SCRAP—every pound that you can find. It may mean another tank—at least another shell which may be the difference between victory or defeat in a battle.

Put this story on your bulletin boards (we'll gladly send reprints). Set a special day or week for digging up scrap. Appoint a competent committee to see that it is done thoroughly. You'll be surprised when you find how much scrap you have. Then call your nearest junk or scrap dealer. He'll pay you for it and send it on to the steel mills.

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POINTS THE WAY TO WINGS FOR ALL AMERICA



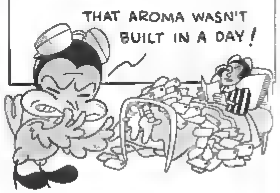
The Birdmen's Perch

Oh, see the little Major,
He's out upon a twig.
He promised to name Oily but
The job grew much too big.

The letters came in bunches—
The Major read and read,
He read while he was eating,
He read while in his bed.

He read under the shower,
He read the postal blitz
In restaurants and buses,
In Washington and Pitts

The Major still is reading.
But takes time off to vow
That Oily will be christened
Just four weeks from now

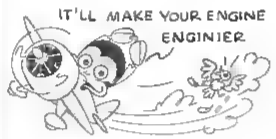


Major Al Williams

ollas, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa

MOIST, HAVE BEEN SOME THINGS THEY WET

Remember a while back, when scientists discovered a way to make water *wetter*? Well, Gulf's scientists discovered a way to make oil *oilier* when they invented the Alchlor Process. For no matter how good the crudes, all oils contain molecules that form carbon and sludge, in addition to the molecules that actually lubricate.



Gulf's exclusive Alchlor Process gets *more* of these carbon and sludge makers out of Gulfpride than ordinary refining techniques would, leaving Gulfpride an *oilier* oil.

BRAINTWISTER (The Good Ferry)

The planes at Newfoundland Airport were joined by 1 flight of 7 new planes each day for a week. After each new flight arrived, half the planes on the field took off for England. At week's end, there were 8 planes left on the field.

How many were there in the beginning?



WHOPPER

Dear Major,

Recently one of the instructors went fishing, carrying as always a small bottle of Gulf Aviation Gasoline for emergencies. After fishing a while, he ran out of bait and headed home to the Station. Half a mile up the path he saw a big snake with a frog in its mouth. He walloped the snake with a stick, took the frog, and started back to the river for more fishing.

But the death struggles of the snake were too much for his soft heart. Having no water, he gave the snake a shot of



G.A.G. and returned to the river, feeling a propet Christian.

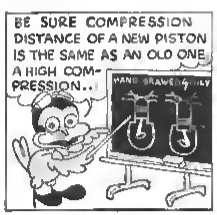
He fished a bit before he felt a tug on his trousers. He looked down to see the same snake with another frog.

W. Bruce Haughton, Senior Instructor, Airplane Phase, Navy Air Service School, Florida

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Official Photograph U. S. Army Air Corps

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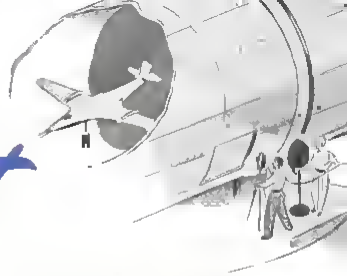
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- ☐ Airline Pilot
- ☐ Commercial Flight Instructor
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- ☐ Aeronautical Engineering
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- ☐ Aircraft Sheet Metal
- ☐ Aircraft Assembly Mechanic
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As a result of this new technique it is now possible to *see*, record, and measure the flutter of wings and other airplane surfaces, simulating almost any conceivable condition which might be encountered in actual flight. Thus, the flutter characteristics of newly designed aircraft may be analyzed, and more accurately predicted prior to actual construction, thereby eliminating much costly full-scale experimentation and delay

As a further contribution to our country's war effort, we shall be glad to share our flutter research experience with other aircraft manufacturers, subject to the limitations which may be imposed by our research and production schedules.



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Try this screw yourself! Send for our free, handy kit of testing samples—contains several different types in a variety of head styles and sizes. See how you can save taps and time on any fastening job—write for yours today!



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LOCKING SCREWS • RADIO AND INSTRUMENT GEARS • COWL FASTENERS • SPECIAL STAMPINGS

HOW TO GET THE MOST OUT OF YOUR LATHES

No. 2 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production.

Keep Them Well Oiled

For lack of oil the bearing was lost,
For lack of a bearing the tank was lost;
For lack of a tank the battle was lost,
All for the lack of a film of oil.

Cleverly paraphrasing the ancient rhyme about the horseshoe nail, a young army officer is said to have used the above verse to emphasize the importance of lubrication in mechanized warfare. And this thought is just as applicable to the battle of production in American shops as it is to the tank battles in distant lands.

The proper lubrication of lathes and other machine tools will contribute much to our total war effort by preventing unnecessary interruption of production. It will also save scarce strategic materials and highly skilled technical labor by reducing to a minimum the demand for replacement bearings, parts, and machines.

South Bend Lathes, like other fine machine tools, have large oil reservoirs, felt wicks, and oil retainers to guard against lack of oil due to temporary neglect or oversight. But for best results the lathe should be oiled at regular intervals. Even a camel must have an occasional drink.



All bearings should be oiled at regular intervals

Make Oiling a Habit

All oil holes and oil cups on the lathe should be filled at least once a day — oftener when the lathe operates day and night — or when top speeds and feeds are employed. The best method is to fill each oil hole in a regular sequence so that oiling becomes a habit and no oil holes are overlooked. When the lathe is in service on two or more shifts, oiling the lathe should be the first daily task of each operator.

To help the inexperienced operator find the oil holes, a circle of brightly colored paint may be applied around each oil cup. Different colors of paint can be used to indicate different grades of oil.

Use Correct Grade of Oil

When the correct grade of oil is used in a well designed bearing there is little or no metal to metal contact and practically no wear. However, when the wrong grade of oil is used, or if the oiling is neglected, the oil film will break down and the fine finish of the bearing surface may be damaged in a short time.

The V-ways of the lathe bed, and the dovetails should be oiled as often as is necessary to maintain a good oil film. Touching the bed way with the tip of the finger will indicate whether or not it is coated with a film of oil.

Motors should be lubricated according to the motor manufacturer's instructions which are usually attached to the motor. Care should be taken to avoid getting oil on rubber V-belts or flat leather belts, as it is injurious to both.

Clean Lathe After Oiling

After the oiling has been completed, the excess of oil should be wiped off with a clean cloth. The lathe should be kept clean. Dirt, chips, or rust should not be allowed to collect.

Write for Bulletin No. H2

Bulletin No. H2 giving more complete information on oiling the lathe will be supplied on request. Oiling charts for South Bend Lathes, and reprints of this and other advertisements in this series can also be supplied. State quantity wanted, also serial numbers of lathes for which oiling charts are needed.

SOUTH BEND LATHE WORKS

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Aeroloy

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Send for the new 50-page Aircraft Catalog (on business letterhead, please) for complete information on all types of cutters, rivet sets, angle drills, bucking bars and other tools.

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. . . and YOU!

Silly? To air condition rivets? Not at all. When aluminum rivets are cooled to sub-zero temperatures they can be riveted faster and more perfectly . . . *speeding up airplane production.*

Many of us think of air conditioning only in terms of comfort for human beings. Yet today, air conditioning's most important job is to keep the *machines* and *materials* of war industry at desired temperatures and humidities.

To meet these wartime needs, revolutionary advances in air conditioning technique have been made. Temperature and humidity are maintained *far more exactly* than ever before. Equipment is more compact, more flexible.

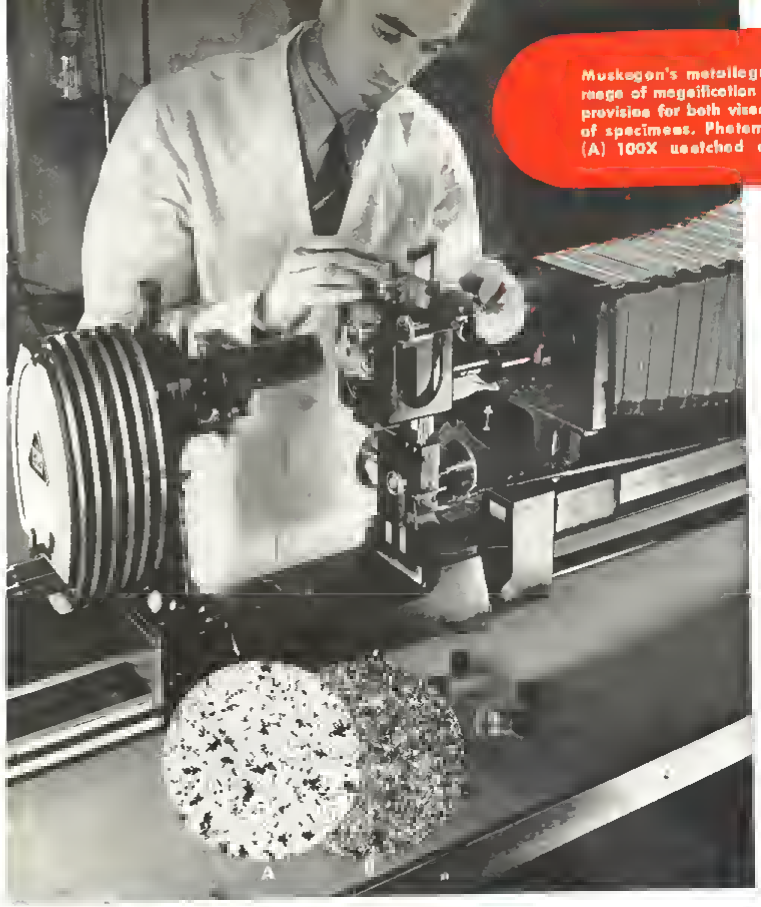
With the coming of peace, this experience will be applied to the making of improved air conditioning equipment for all sorts of uses.

Packaged air conditioners will be smaller, more compact, more economical—many more homes will have them. And in offices and factories, air conditioning will lower costs and increase efficiency. General Electric will be a logical source of all types of this new equipment for air conditioning, refrigeration, heat transfer and heating.

Air Conditioning and Commercial Refrigeration Department, Division 422, General Electric Company, Bloomfield, New Jersey.

Air Conditioning by

GENERAL ELECTRIC



Muskegon's metallegraphic equipment with range of magnification from 3X to 4000X and provision for both visual study and photograph of specimens. Photomicrographs below are (A) 100X unetched and (B) 100X etched.

MUSKEGON MPR PISTON RINGS

. . . Quality Control THE WATCHWORD

MUSKEGON Piston Rings

The prime functions of Muskegon's metallurgists are the establishment of the highest possible standards and their maintenance throughout the production processes. The facilities which have thus been developed are frequently used also to study customers' metallurgical problems on related parts such as cylinders, bearings, valves.

These facilities, as well as Muskegon's piston ring experience are available to all who use piston rings whether in Aircraft or Automobiles—Jeeps or Trucks—Tanks or Tractors.

MUSKEGON PISTON RING CO.

Muskegon, Michigan

Plants at Muskegon and Sparta

We've Learned a Lot

ABOUT SHEET STEEL FABRICATION

in 50 Years

—AND NOW THIS KNOWLEDGE IS AVAILABLE TO YOU

● For more than half a century, Berger has specialized in the production of articles made of sheet steel. Some were developed all the way from the idea stage to quantity manufacture. Many became standard units in Berger's wide line. Others were produced as parts for assembly into various manufacturers' products, or as finished items for their lines.

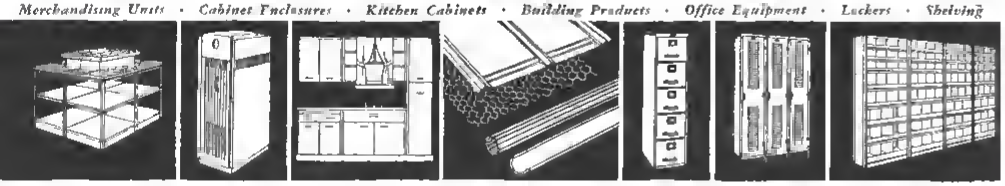
In a business like this, you can learn a lot about sheet steel fabrication in 50 years. And Berger craftsmen today are well acquainted with the possibilities *and the impossibilities* of sheet steel as applied to gain lighter weight, greater strength, higher efficiency, longer life, better appearance, lower cost.

Now, we're offering all of our knowledge and experience to you—to help you produce sheet steel items needed in our war effort—to help you prepare for competitive markets in the days to come

Whatever your problem in sheet steel—design, or fabrication—Berger has the experience and facilities to handle it.

BERGER MANUFACTURING DIVISION
REPUBLIC STEEL CORPORATION
CANTON • OHIO
Calvert Division • Niles Steel Products Division
Steel and Tubes Division • Union Drawn Steel Division
Truscon Steel Company
Export Department Chrysler Building, New York, N. Y.

Merchandising Units • Cabinet Enclosures • Kitchen Cabinets • Building Products • Office Equipment • Lockers • Shelving



The items shown above are only a few of the peacetime products of Berger. Because of war requirements, however, limitation orders restrict or prevent their manufacture now.

BERGER
DESIGNERS • ENGINEERS • FABRICATORS
OF SHEET STEEL PRODUCTS

When considering sheet steel, remember these qualities: strength, light weight, durability, fireproof, versatile in design, variety of finishes, low cost.

TOOLS TO SPEED THE JOB!



IN a plane worker's kit of tools, every feature and detail of design that contributes to speed, precision and flexibility, is as important as in the most advanced automatic production equipment. *Often more important* . . for it is at bench and assembly line that bottle necks may all too easily occur!

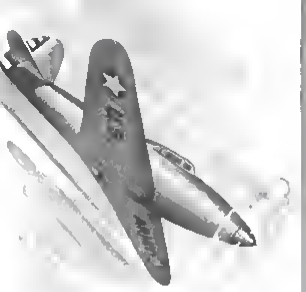
Throughout the aviation industry, there is a strong and steadily increasing preference for Snap-on tools. Their accuracy, flexibility and power lend speed and precision to the most difficult jobs. In tight and tricky places Snap-ons "reach right in", grip hidden nuts securely, turn them solidly.

• • •

The 3,000 tools in the Snap-on line . . and Snap-on's direct-to-you service . . . are conveniently near you through 35 factory branches at key aviation centers throughout America. Send for catalog and full information.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS

SNAP-ON TOOLS CORPORATION
8020-J 28th AVENUE • KENOSHA, WISCONSIN



TAYLOR PIONEERED IN LAMINATED PLASTICS CONSTRUCTION OF VITAL AIRCRAFT PARTS

Taylor Laminated Plastics Construction of Trim Tabs is now standard on such aircraft as the famous Bell Airacobra P-39 Interceptor Pursuit, the Martin B-26-B Bomber and others. It is approved by the United States Army and Navy. Tests are being conducted on this type of construction for trim tabs, servo-tabs, wing flaps and radio antennae masts in many aircraft laboratories.

Pre-fabrication by Laminated Plastics Construction of more and more aircraft parts offers an important means of speeding aircraft assembly. Working with extreme precision from the manufacturer's specifications, Taylor provides the straight-line mass production of a specialist in their field, with unlimited facilities including the manufacture of their own materials.

TAYLOR FIBRE COMPANY
NORRISTOWN, PA
Pacific Coast Headquarters: 544 South San Pedro Street, Los Angeles, Cal.



TAYLOR

LAMINATED PLASTICS • Vulcanized Fibre • Phenol Fibre • ***SHEETS, RODS, TUBES, FABRICATED PARTS***



Strengthen America's Good Right Arm!

EQUIPMENT FOR FIGHTING MEN DEPENDS ON PAPER WORK ROUTINES

● To give our fighters the planes, ships and field equipment they must have in the shortest possible time, *production* must be fast. We dare not waste time. Lost minutes weaken our striking arms in the air, on the sea and on land.

The men and machines in the front lines of production are under control of *paper work routines.* Capacity output requires precision functioning of instructions, information and record facts —on business forms. To insure *speed, accuracy* and *cost protection* is work for Addressograph-Multigraph methods.

These methods *simplify* and *organize* the preparation of paper work on which capacity production must rely. They save *time*, prevent *mistakes*, eliminate *waste*, improve and speed up *results.*

USERS OF OUR PRODUCTS are entitled to the services of our Methods Department. It can help to extend the use of their equipment in Purchasing, Storekeeping, Production, Marketing, Shipping, Billing, Collecting, Disbursing and all key operations of business. To those who are interested in up-to-date information on better methods it is available on request, without charge.

ADDRESSOGRAPH-MULTIGRAPH CORPORATION • *Cleveland, Ohio*
Addressograph and Multigraph are trade-marks registered in the United States Patent Office



will beat Nature at her own game!

The war has shown with painful clarity how dangerous it is to depend upon distant sources of supply for materials essential to American security and standard of living.

Take rubber. Every home, every individual from infant to octogenarian has been affected by the conservation of our precious rubber stocks.

It is an American tradition to be independent and self-sustaining. We are making our own rubber now—Hycar is better than tree rubber ever was. American resources provide the basic materials. American ingenuity and scientific research provide the know-how. Hycar, a butadiene synthetic, is being made in a variety of grades, with physical properties controlled for specific uses. It is longer lasting and more efficient than nature's rubber.

The thousands of tons of Hycar being produced are going into the most important war industries. After the war, Hycar, America's own synthetic rubber, will continue to replace tree rubber for countless services in the oil industry, in machine manufacture, in automobiles and aircraft, and in domestic use.

Hycar crude synthetic rubbers are furnished to manufacturers of finished rubber products. Your rubber supplier can exploit the superior qualities of Hycar. If you are making a war essential, our research laboratories and engineers will gladly cooperate to speed production and determine the best type of Hycar for your particular application.

HYCAR CHEMICAL COMPANY, *Akron, Ohio*
RESEARCH • ENGINEERING • PRODUCTION



Weight can make the Favorite an "Also-Ran"

Excess weight can cut the performance of your plane just as it can kill the chances of a race horse. Hycar can help you reduce the weight of your champion of the air because Hycar is 15% to 25% lighter than many synthetics. In addition, Hycar gives you excellent resistance to heat, cold, petroleum, compression-set and abrasion. Our experience, our technical help and facilities are at your disposal, to give you the characteristics you need in a *lighter* material.

HYCAR Synthetic Rubber

LARGEST INDEPENDENT PRODUCER IN AMERICA OF BUTADIENE SYNTHETIC RUBBER





Sealed Power is in this fight!

On the engine firing line as the global war rages are millions of Sealed Power piston rings, pistons, and cylinder sleeves. You'll find them in bombers, fighters, tanks, jeeps, motorcycles, mobile radio units, torpedo boats, tank landing boats, destroyers, submarines.

Sealed Power products in Diesel engines are saving fuel, saving oil, safeguarding bearings, journals, and cylinder walls on every front in our country's struggle for Victory.

Engine manufacturers, car and truck manufacturers, plane builders, boat builders, repairmen, fleet operators, Army and Navy officers are invited to consult Sealed Power Engineers on any of their engine problems.

BUY WAR BONDS



SEALED POWER CORPORATION

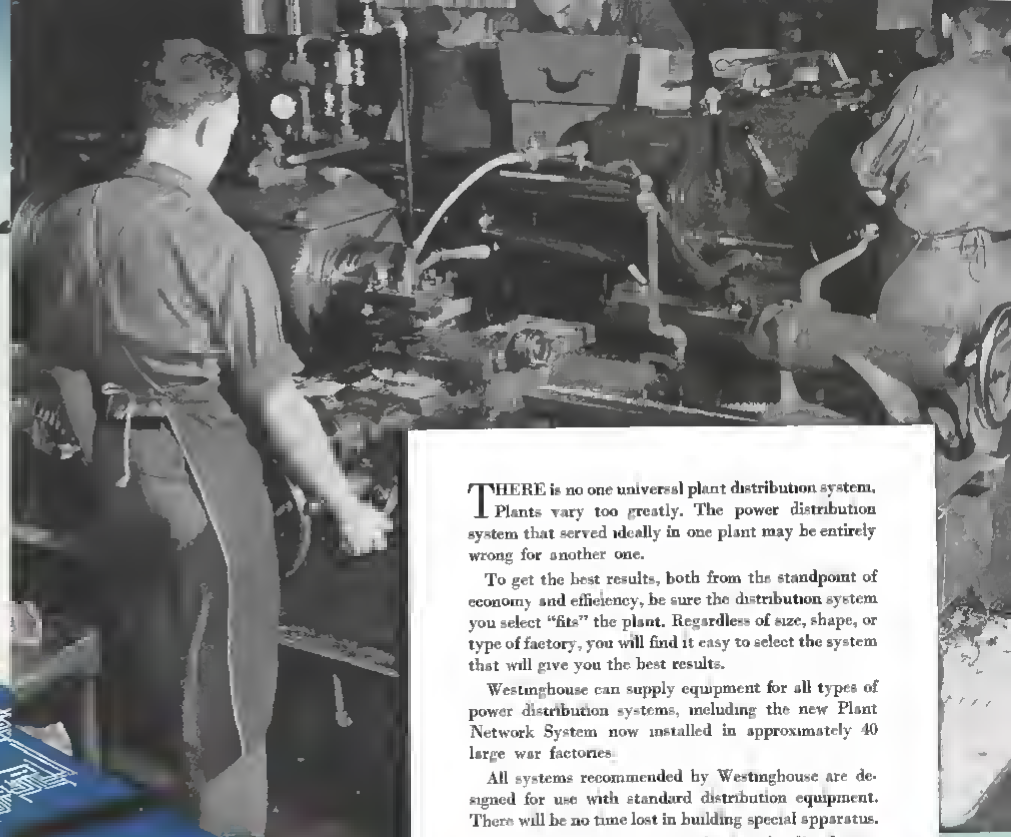
Pistons, Piston Rings, Cylinder Sleeves for all types of internal combustion engines, pumps, compressors, etc.

Muskegon, Michigan • Windsor, Ontario

TO GET THE BEST DISTRIBUTION SYSTEM . . .

Choose the system that "fits" the plant





THERE is no one universal plant distribution system. Plants vary too greatly. The power distribution system that served ideally in one plant may be entirely wrong for another one.

To get the best results, both from the standpoint of economy and efficiency, be sure the distribution system you select "fits" the plant. Regardless of size, shape, or type of factory, you will find it easy to select the system that will give you the best results.

Westinghouse can supply equipment for all types of power distribution systems, including the new Plant Network System now installed in approximately 40 large war factories.

All systems recommended by Westinghouse are designed for use with standard distribution equipment. There will be no time lost in building special apparatus.

To help you save time in selecting the distribution system that best fits your requirements, Westinghouse has prepared a special book that briefly describes a group of different plant distribution systems. Just fill in and mail the coupon for your copy.

If you want faster action, call our local office. One of our engineers will be glad to discuss your distribution problem with you.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.



FREE QUICK FACTS ABOUT PLANT DISTRIBUTION SYSTEMS

Westinghouse Electric & Mfg. Co.,
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Please send book B-3152 giving quick facts on Westinghouse Distribution Systems.

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PLANT DISTRIBUTION SYSTEMS

FEDERAL

Aircraft

BEARINGS





FEDERAL SPECIALIZES IN THE PRODUCTION OF QUALITY BALL BEARINGS • ITS POLICY IS TO MAKE THE FINEST BALL BEARINGS REGARDLESS OF ANY OTHER CONSIDERATION • THE FEDERAL ORGANIZATION IS DEDICATED TO THIS ONE PURPOSE—THIS ONE IDEAL •

THE FEDERAL BEARINGS CO., INC.

Makers of Fine Ball Bearings

POUGHKEEPSIE, N. Y.

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Complete line of electrical contactors, relays, circuit breakers, built to specifications, accepted by Army and Navy AND IN MASS PRODUCTION

There's no need to lose time waiting for airplane electrical contactors, relays or circuit-breakers today. What you need is almost sure to be *in* the Cutler-Hammer line. The development work's been done. The C-H line is the most modern accepted and service-proven designs, built to specifications, accepted by both Army and Navy, and already in mass production. These are designs by C-H engineers long familiar with aviation needs and known the world over for their leadership in electrical control equipment. Samples can be sent you immediately. Simply name your requirements *today*. CUTLER-HAMMER, Inc., 1413 St. Paul Avenue, Milwaukee, Wisconsin. Associate Canadian Cutler-Hammer, Ltd., Toronto.

1892-1942 50th ANNIVERSARY

CUTLER-HAMMER
MOTOR CONTROL
C-H

Features THAT COUNT

These aren't adaptations. These are *specific designs* for actual airplane operating conditions.

- Not just one or two items or types but a complete line from 25 to 200 amps; single pole, single throw; single pole, double throw; double pole, single throw; double pole, double throw
- Tremendous reserve capacity built into every item.
- Capable of handling emergency peak or short circuit currents
- Will operate in any position at maximum required acceleration
- Tested for operation at maximum flight altitude
- Inherent hammer blow construction assures positive operation under all conditions. Coils have famous C-H Vacuum Impregnation against failure.



A. C. Magnetic Control Aircraft Contactor 100 amperes 24 volts, with inverted terminals.



Airplane relay 25 amperes S. P., S. T.



Aircraft Circuit Breaker 50 amperes 30 volts.

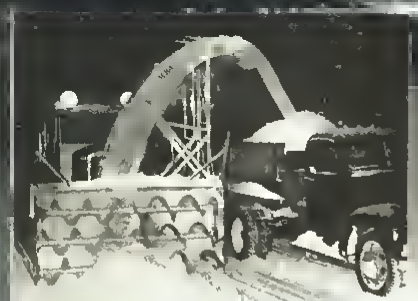
INSTRUMENTS can find the airport in the dark. Instruments can put the ship on the ground — but instruments won't leave a clean, firm winter runway.

From Alaska to Nova Scotia—from Seattle to New York, wherever that Saboteur Winter blasts the airport Snogo is making winter flying safer.

Snogo *removes* the snow from the runway and when Snogo is through, the job is done until the next snowfall. There is no packed layer of snow to freeze into dangerous ruts or thaw into mushy spots. There won't be any heavy slush to freeze in wheel pants or be carried into wheel wells. There is no expensive rehandling, no plowing to condition snow as with rolling, no banks to blow back on the runway or endanger wing tips. Snogo keeps 'em flying in any winter weather and *remember*—one washout pays for a Snogo!

•

KLAUER MANUFACTURING COMPANY
Dubuque, Iowa



SNOGO

For Complete Snow Removal

A SAFE LANDING *Tonight!*



LET'S GO! U.S.A. KEEP 'EM FLYING!

POSITIVELY GUARANTEED

to handle any snow conditions that will ever occur on any Airport!



"WORKBENCHOLOGIST"

Webster *did not* have a word for it...

Yes, the word "workbenchologist" is of our own making, but it is, we think, descriptive of one who has become an expert on the subject of Work *Bench Design* and *Manufacture*. And, certainly, we can modestly lay claim to that distinction because we have probably made the greatest variety of styles and sizes of benches. We have adequate facilities for speedy production and, finally, we understand the needs of an extremely wide variety of Work-Bench and Shop Equipment users.

So, as "workbenchologists" we offer a complete line of benches in 1367 different combinations and of 5 different leg heights.



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JENKINTOWN PENNA. BOX 566
—BRANCHES—
BOSTON DETROIT INDIANAPOLIS CHICAGO ST. LOUIS SAN FRANCISCO



"BOY, WHAT SWEET PERFORMANCE AT HIGH ALTITUDES!"

(AND THAT COMPLIMENT INCLUDES THE BLACK & DECKER MOTORS)

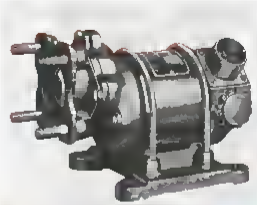
"SWEET PERFORMANCE" in motors is just another way of saying *thorough engineering*, combined with maximum care in every step of manufacture.

Nothing gives us greater satisfaction than to know that our many years of experience in designing and building all types of special application motors is going into the production of *aircraft* for our own forces and the Allied Nations.

We shall welcome the opportunity to apply this experience to the design of a motor for any plane equipment you may have under consideration.

Write for complete information about our engineering service.

THE BLACK & DECKER ELECTRIC COMPANY
KENT, OHIO

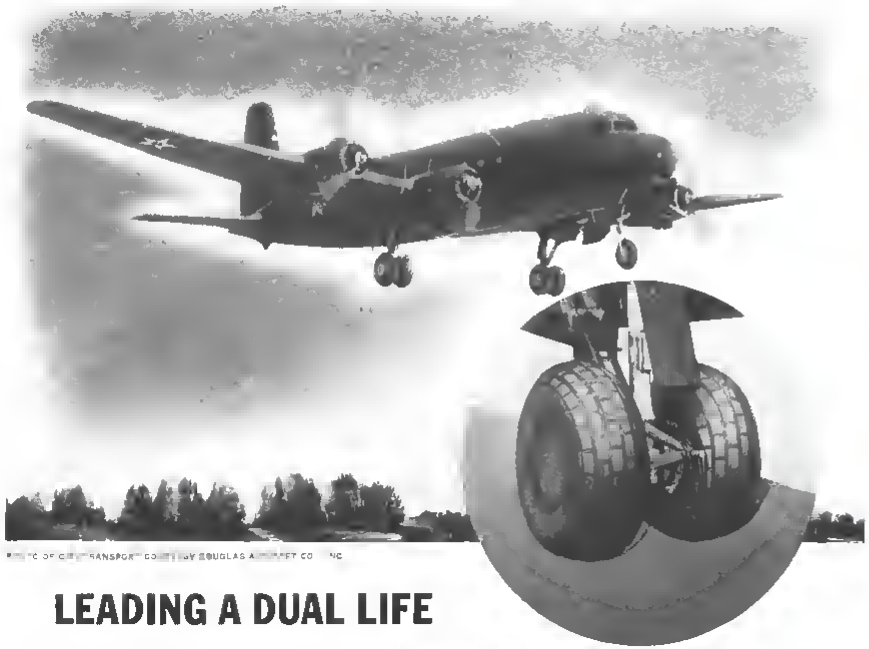


Thorough engineering is the basic factor behind the dependable performance of this and many other special aircraft motors we have designed and built.

FRACTIONAL HORSEPOWER ★ SPECIAL APPLICATION

BLACK & DECKER

MOTORS



LEADING A DUAL LIFE

WHAT landing gear to put on such a big ship and where to put it were the problems handed to "U. S." engineers.

One of them suggested dual wheels and tires. Experiments with airplane duals showed greatly increased flotation. They spread the load over more surface, increased the usefulness of the plane by multiplying the number of places where it might land and take off.

Other advantages developed, too. With *dual tires* retracting space was better designed and more compact. Tires could be smaller, lots easier to install and to service.

So airplane tires now lead a dual life. Performance is increased; everyone is happy.

Could you make use of practical field assistance on tire and undercarriage problems? There is a whole staff of "U. S." field engineers ready and eager to jump at problems like that.

ROYAL AIRPLANE TIRES

ONLY "U. S." HAS THESE EXTRAS

1. **TEMPERED RUBBER TREAD**—A rougher, scuff and heat resistant tread compound for airplane tires.
2. **SAFETY BONDED RAYON CORD**—A lighter, more resilient, airplane tire material with tremendous impact resistance and stamina at high temperatures.
3. **FIELD AIRPLANE TIRE SERVICE**—A force of "U. S." field engineers in every part of the country is promptly available for engineering and technical help on tire and undercarriage problems.
4. **"U. S." ICE GRIP TREAD**—A tread of revolutionary design and performance for snow and ice-covered landing surfaces.
5. **STATIC GROUND CONSTRUCTION**—Conductive rubber construction grounds static electrical charges upon contact with the ground. This safety feature is available in every U. S. Royal Airplane Tire.

RAYON IN EVERY U. S. TIRE — A U. S. TIRE FOR EVERY PLANE

UNITED STATES RUBBER COMPANY

AIRPLANE TIRE DEPARTMENT • 6600 E. JEFFERSON AVE. • DETROIT, MICHIGAN



HE GIVES THE TOOLS...WE'LL DO THE JOB!

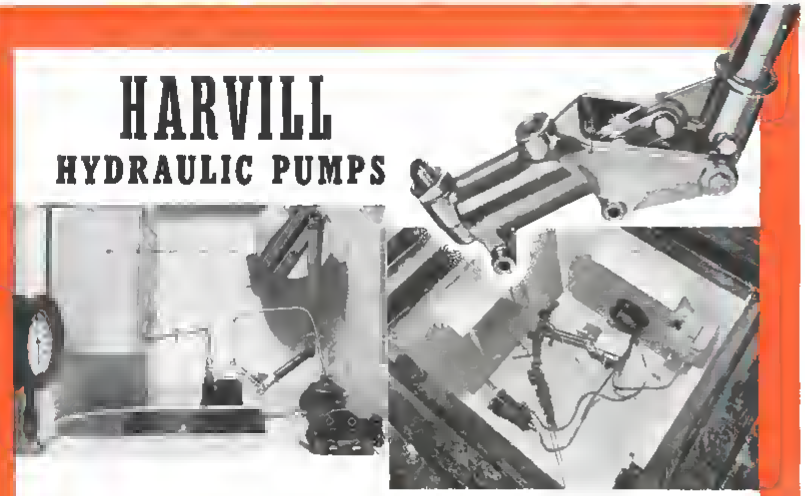
The Aviation Industry started on its own. Given the orders, facilities and equipment, it has the know how to make good its promise to—

RULE THE BLUE IN

Howard Aircraft Corporation

5301 WEST SIXTY-FIFTH STREET, CHICAGO, ILLINOIS, U.S.A.

HARVILL
HYDRAULIC PUMPS



Thoroughly Tested under severest conditions

Each part in Harvill Hydraulic Hand Pumps has been thoroughly tested—using production line Pumps identical to those now being delivered to the industry in ever increasing numbers

During life tests a line pressure of 1500 p s i was maintained for over 120,000 cycles at the rate of 60 cycles per minute. Cold chamber tests included operation at minus 67 deg F , and hot chamber tests up to 140 deg F

At the end of the tests the Pumps were delivering their full volume, Air Corps specifications were fully met, no appreciable wear was evident

* * *

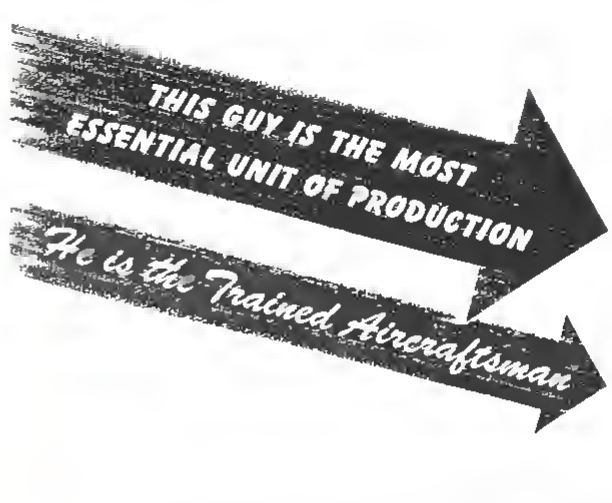


PRESSURE MOLDED
for Controlled Quality

The pump bodies and fulcrums are produced by the Pressure Mold Casting process—which substantially reduces material requirements and machining time This casting method also assures a faster production rate a higher degree of uniformity and a substantial reduction in cost—to a degree that can be achieved only by this process.

Pressure Mold castings are fully approved by the Air Corps they give higher mechanical properties than any other type of casting and open entirely new fields for time and cost savings. Write for full details.

HARVILL
Corporation
HYDRAULIC DIVISION
6251 WEST CENTURY BLVD. • LOS ANGELES, CALIFORNIA
Eastern Representative: Harvill Processes Corp., Federal Trust Bldg., Newark, N. J.



Aviation has JOBS for thousands, but CAREERS only for trained men!

Aviation executives face tremendous organization problems in the production of 185,000 warplanes. They have been forced to accept thousands of single phase workers from cheap "quickie" courses, but the vital supervisory positions that bridge the gap between raw material and fighting ships can only be filled by men thoroughly trained to solve any problem assigned to them. The career man with long range training is the ESSENTIAL unit of production — and ONLY he will continue to be essential through the readjustments that must follow when America's war production shifts back to peace time schedules.

The executives who have made aviation THEIR career knew that the value of each man is governed by two factors: his intelligent sincerity in selecting aviation as his life work, and THE ABILITY AND EXPERIENCE OF THOSE WHO TRAIN HIM FOR THAT CAREER. They knew that Curtiss Wright Technical Institute graduates are — and for many years have been — thoroughly qualified to fill the industry's exacting requirements.

Located in the very center and a very important part of Southern California's great aircraft industry with its more than two billion dollars in unfilled orders, Curtiss-Wright Tec has come to be recognized as the nation's leading institution for the training of Aeronautical Engineers and Master Mechanics. Mr. Donald Douglas, President of the great Douglas Aircraft Company, chose this school for his own son's training which pointedly indicates the high standing Curtiss Wright Tec has attained in the aircraft industry since its establishment in 1929.

It is imperative that before you invest in a course of career training you determine what the returns will be on your investment. Is your choice of a school in which to take your training will determine how much money you will make all the rest of your life.

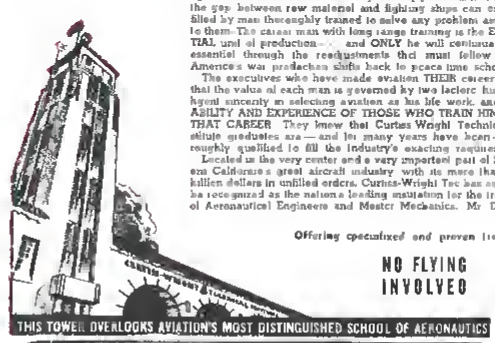
Curtiss Wright Tec's career training is carefully designed to do just one thing:—TO MAKE MONEY FOR YOU so that upon graduation you can be independent and self supporting for life. Our thousands of successful graduates have proven that Curtiss-Wright Tec training gets results and always pays; since it trained them in advance for the highest position they could ever expect to occupy. It can do the same for you.

This school has never guaranteed positions for its graduates, but practically every graduate has obtained immediate employment and is advancing rapidly. The demand for our graduates far exceeds the supply and we honestly believe that every student who enrolls here will be able to obtain, with our assistance immediate employment upon graduation.

WARNING! — Don't miss the boat." The greatest opportunity in your lifetime exists today! There never was such an opportunity in aviation for you there may never be another. A position awaits you. Insure for yourself a steady income and independence for life. DON'T FOLLOW — LEAD! Send in your enrollment before you miss the boat."

Offering specialized and proven training in AERONAUTICAL ENGINEERING & MASTER MECHANICS

NO FLYING INVOLVED



CURTISS WRIGHT TECHNICAL INSTITUTE

GRAND CENTRAL AIR TERMINAL 1226 AIRWAY GLENDALE (LOS ANGELES) CALIF.
UNDER PERSONAL SUPERVISION OF MAJOR C. C. MOSELEY, OWNER SINCE ITS ESTABLISHMENT IN 1929

Contractor to the U. S. Army Air Corps

WISE PROTECT YOUR FUTURE

MAIL TODAY • DON'T DELAY

- ☐ AERONAUTICAL ENGINEERING COURSE
- ☐ MASTER AVIATION MECHANIC COURSE
- ☐ SPECIALIZED ENGINE COURSE
- ☐ SPECIALIZED AIRPLANE COURSE
- ☐ SPECIALIZED AIRCRAFT WELDING COURSE
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- ☐ SPECIALIZED AIRCRAFT SHEET METAL COURSE
- ☐ AERONAUTICAL DRAFTING COURSE HOME STUDY
- ☐ AIRCRAFT BLUE PRINT READING COURSE HOME STUDY

NAME

ADDRESS

CITY STATE AVIO



MADE FOR COMBAT SERVICE

"Get on his tail and stay there!" That command calls for fighting courage and the utmost coordination of pilot and plane. Every accessory must function perfectly, especially the instrument, fuel, oil and hydraulic life lines. Flex-O-Tube Hose Assemblies are made for strenuous service. The toughest materials are carefully selected and each step in their manufacture is based on specialized experience in the development and manufacture of heat, cold, vibration, pressure and solvent resisting flexible fluid conductors. Result—a hose assembly as able to do its job as the pilot who depends on it.

Standardized sizes and types to suit every installation. More applications with fewer parts. Engineering counsel and manufacturing skill based on years of pioneering devoted exclusively to flexible hose assemblies for aircraft, automotive, marine and machine tool applications. For complete information, contact nearest office.



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ALERT
to America's Needs OF TODAY *...and Tomorrow!*

SPARTAN
AIRCRAFT COMPANY

SPARTAN SCHOOL OF AERONAUTICS

This top-ranking school operated as a division of the Spartan Aircraft Company has established an enviable record for turning out excellently trained men. Today Spartan School graduates are serving the aviation industry in every type of position . . . and an ever-increasing number of thoroughly trained Spartan School aircraft workers are being graduated to aid private industry and the military air forces.

When the call came to serve a fighting America, Spartan was ready . . . with the experience, the skill and the equipment to fulfill vital government contracts. Day after day, hour after hour, precision machinery maintains a ceaseless hum in the Spartan factory under the watchful eyes of Spartan's soldiers of production.

Spartan is also alert to America's aircraft needs of tomorrow. Constant research foretells the day when, to a world at peace, Spartan will announce a new and finer plane . . . built to the same top-quality standards of the famous Spartan "Executive" . . . designed in keeping with the developments of the future.

America will win the victory and the peace! Spartan will be ready!

SPARTAN AIRCRAFT COMPANY — TULSA, OKLAHOMA

★ BUILDERS OF FINE AIRCRAFT SINCE 1929

★ CONTRACTORS TO THE U. S. ARMY AND U. S. NAVY



To the armed forces

The entire personnel of the Sperry Gyroscope Company is deeply honored in being among the first to receive the joint Army-Navy Production Award *for high achievement in the production of war equipment*

We at Sperry are determined to see the job through. This recognition from our armed forces will be a continuing source of inspiration to us.

SPERRY GYROSCOPE COMPANY, INC.

BROOKLYN, NEW YORK



THIS IS THE SIGN that hangs on the bolted doors of a small repair shop near Fort Worth, Texas. A young man in his twenties, who used to work here, was one of the gallant band who fought on Bataan. His fifty-year-old father, owner of the shop, and two teen-age brothers are fighting men too. They're building planes for North American.

Not all our employees, of course, have the example of a son or brother in the armed forces to inspire them. But there's not a single North American worker who doesn't understand his personal stake in victory, who isn't grimly proud of his part in bringing the day of victory closer.

This will to win is the foundation for North American teamwork. It makes bombers, fighters, and training planes come out of our plants *fast*. It is the reason why, instead of "freezing" designs, we steadily improve our planes, making each one the very best plane that we can produce on any given day.

Some day, "after Hitler's funeral," North American teamwork will be building planes to dominate the skies of peace. Until then the sweetest music to our ears is the chuffing of trains delivering materials to us, the hum of production, the full-throated roar of each new North American plane as it flies away to strike at America's enemies.

NORTH AMERICAN AVIATION, INC.

Main Plant Inglewood, Calif

Member, Aircraft War Production Council, Inc.

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For Aircraft Engineers With a Future!

Photo Courtesy of Fleetwings, Inc.

Spot welding of aluminum alloys is being applied more and more to stressed members of airframes . . . helping to produce stronger, lighter, rivet-less structures for modern warplanes. But spot welding is still a relatively new technique for assembling aluminum alloys.

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- Design of spot welded joints. Diagrams, tabular data, graphs and discussion.
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Write today for your free copy of "Spot Welding Aluminum Alloys". It belongs in your technical library to supplement the 79 page Mallory Resistance Welding Data Book . . . another "must" for aircraft engineers.

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For fabricating military and naval aircraft, Mallory Standardized Resistance Welding Electrodes are widely used . . . for spot, seam, flash or butt welding of ferrous and non-ferrous metals and alloys. Mallotron Capacitors improve the performance of Condenser Discharge Spot Welders.

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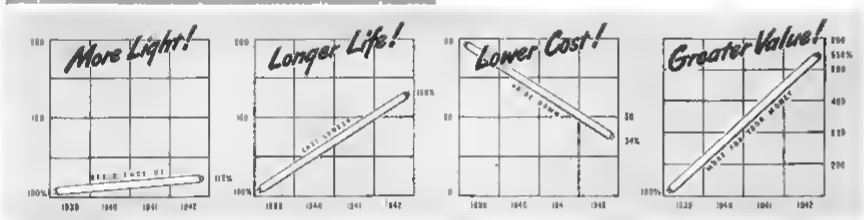
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G-E MAZDA LAMPS

GENERAL ELECTRIC



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Rails end . . . seas have shores . . . but cargoes sent by air go directly to destination without transhipment. For swift tonnage transport which reaches everywhere, Wright engines supply the power.

WRIGHT *Aircraft Engines*

POWER THE TONNAGE OF THE AIR



Part of a task force boards a nine place glider. Many makes of these new craft are being fabricated with Boots Self Locking Nuts

They arrive all set to take over. This is the way glider troops will soon be carrying out assignments on many fronts

Glider Assignment

The entire line of Boots Self-Locking Nuts is carrying out an important assignment with spectacular effectiveness in the rapidly expanding glider industry.

This is particularly true of the Boots "Cage" Nut. Specially devised for use in building planes of plywood and plastics, this recent addition to the Boots family has proved itself indispensable in attaching glider fillets and fairings, in mounting instruments to dashboards, and in many other applications requiring a positive self-locking device. The "Cage" Nut combines the familiar Boots all-metal Wing Style Nut with a special base designed to be clinched permanently into the plywood. Applying it is a *one man* operation, as it can be clinched in from *one side*. Its grip is so firm that it withstands—without tearing the plywood—the torque of bolt or screw insertion when applied by production methods.

In short, the "Cage" Nut is making possible increased substitution of plywood for vital aluminum in many aircraft applications. Remember, Boots Nuts "Outlast the Plane." Send for new catalogue today.

General Offices
New Canaan, Conn.

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AIRCRAFT NUT CORPORATION



The Boots "Cage" Nut, ready to fasten plywood sub assemblies for faster production.



The special tool for fastening the "Cage" Nut to the plywood



When applied, the "Cage" Nut grips the base sheet of plywood permanently. Now it is ready to be bolted to adjacent part of the plane

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And it's firepower that is *always* concentrated from muzzles to target, at any range — because it comes slamming from the nose of that unobstructed center cockpit. It's a battle axe of lead and explosives that can slice off a Messerschmitt wing, or blast a Jap Zero to bits — and it's another reason why a plane christened "Interceptor Pursuit" in defense minded days fits so well its new official air force title, "Fighter."

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for protection today, and progress tomorrow, look to

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One thing above all others makes Formica the valuable material it is in so many industries — electrical, mechanical, aviation, chemical, and that is: once a Formica part is installed it remains unchanged almost regardless of conditions. It really stays put!

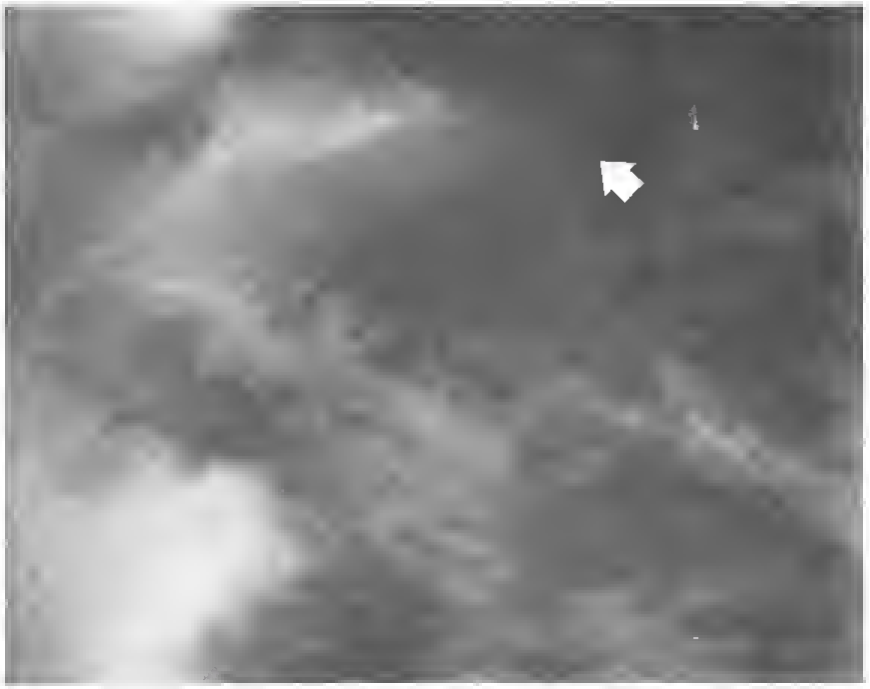
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Photograph of a Flying Fortress—seven miles up

This is the way a Flying Fortress* looks to the enemy, on its way to the bombing objective. At six and seven miles up, an airplane is invisible to the naked eye, and one of the reasons for the success of the Flying Fortress in combat is that it strikes with deadly precision from regions above the effective range of anti-aircraft fire, and beyond the reach of most enemy planes.

Seven miles is 36,960 feet. Problems of flight that high in the air increase in severity with every hundred feet. The air up there is colder than Siberia in winter, and atmospheric pressure falls off sharply. The stratosphere is still a newly discovered country. Until recently, one of the major problems has been the maintaining of communications.

A year ago 19,000 feet seemed to be the ceiling for plane-to-ground voice communication. Above that, somewhere in the thin, biting air of the substratosphere the radio-telephone died. Radiotelegraph was good up to 26,000. From there, it was a one way street. You could receive, but you couldn't send.

Here was a problem for Boeing acoustical and electrical engineers. Years ago, in the early days of air transport, Boeing led the development of the first plane-to-ground short wave radiotelephone system. Now, with Boeing Flying Fortresses operating six, seven and more miles above the earth, it was necessary to provide two way radio voice communication at these levels.

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Working nights and days, working in the laboratory and upstairs in the stratosphere, working against time and cold and rarefied air, Boeing engineers have gradually pushed the communications ceiling higher and higher.

Today the men in the Fortresses, cruising over the roof of the world, know that their communications system is the best available. Today the work of Boeing engineers is helping our Air Forces to speak terse, well chosen words for democracy.

The advance of radio communication both for peace and for war is only one of the many different projects which form a constant part of the Boeing engineering schedules at Seattle and in the Middle West and Canada.

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Diving at five miles a minute, a split-second is a long time. To the crew in a bomber it may mean the difference between success or failure. Split-second maneuvering depends upon *instant* response of precision-built motor controls. Through the production of these specially-designed aircraft motors, Emerson-Electric is helping the United Nations to write thrilling new pages in the history of aerial warfare.

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July 30, 1942

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Attention: Mr. J. G. Malone

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This portable brush plating equipment is a necessity in our plant in order for us to meet our delivery schedules and has enabled us to effect a very substantial savings in both labor and material.

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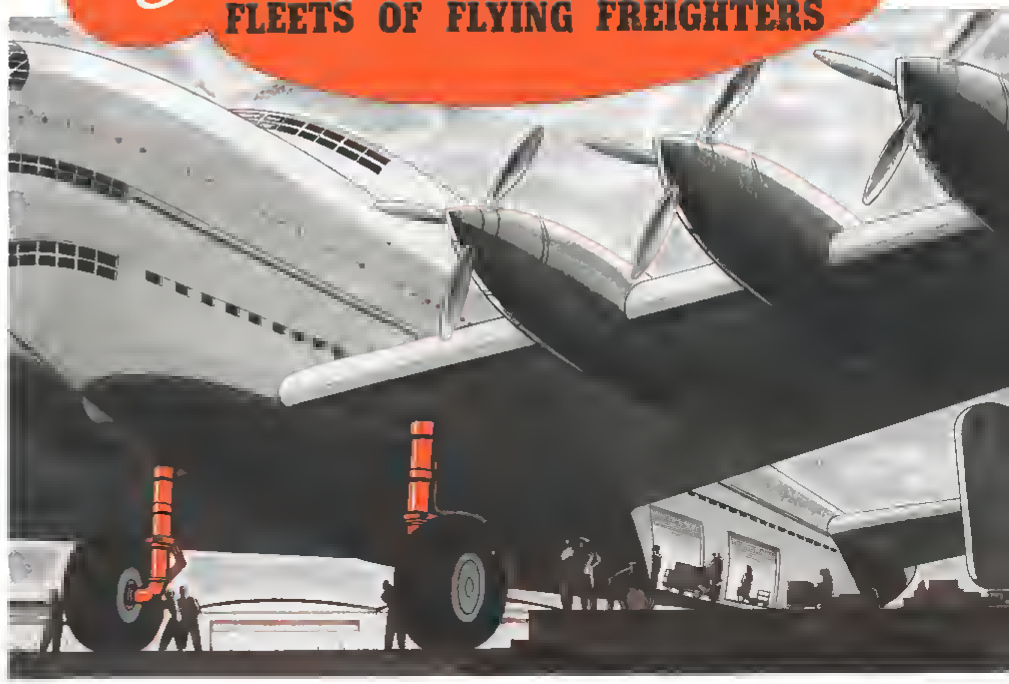
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The CLEVELAND PNEUMATIC TOOL CO.
AIRCRAFT DIVISION . . CLEVELAND, OHIO

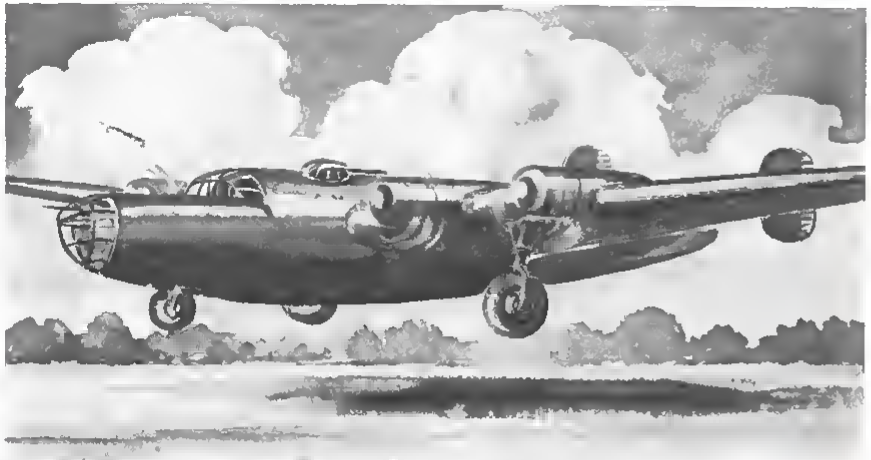
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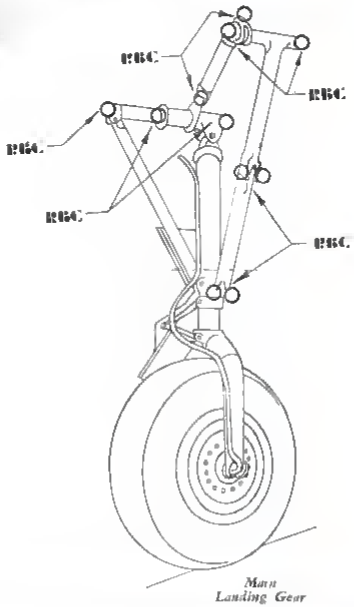
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ILLUSTRATIONS ACTUAL SIZE

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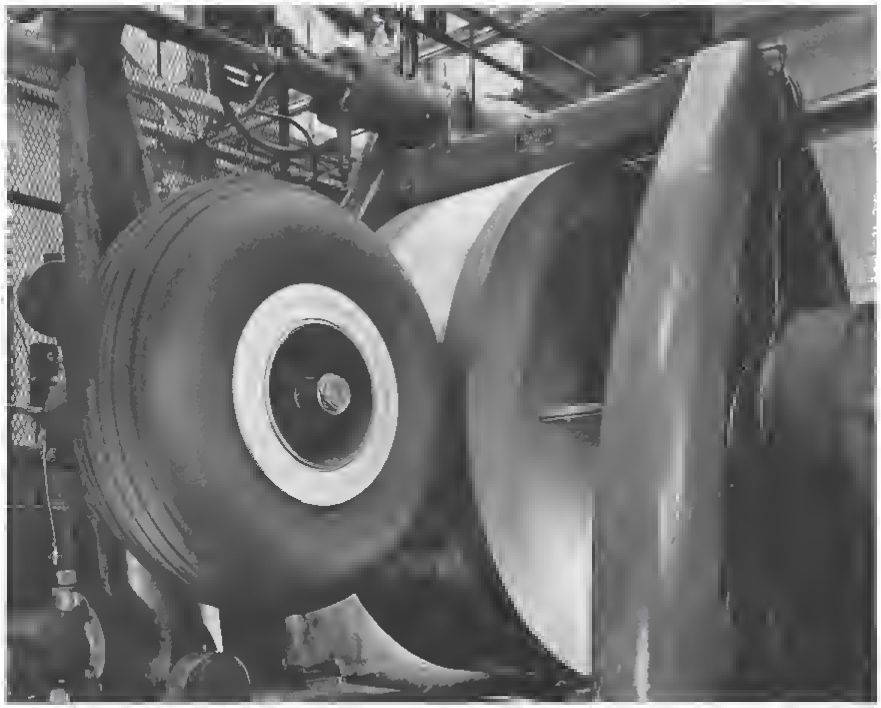
...ve is an electro-magnetic valve designed ... for the dilution of engine oil with gaso... easy starting in cold climates but ... conjunction with any accessories ... 90 p.s.i. straight through valve. ...



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To speed the day when the enemy will feel the full weight of American production for war—manufacturers of parts, equipment and complete assemblies of planes, tanks and guns have turned to Protek-Sorb Silica Gel to guard against loss of time and material due to moisture damage during shipment or storage. Time-wasting slushing compounds are no longer necessary—Protek-Sorb eliminates the cause of moisture damage because it keeps the interior of the container dry. Parts reach the assembly line, fighting tools reach the battle line—clean and ready for immediate use.

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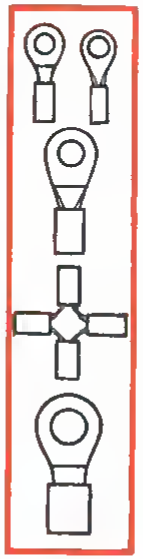
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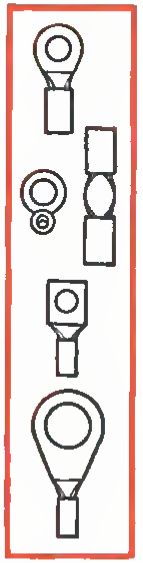
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ARMS FOR THE PRODUCTION ARMY

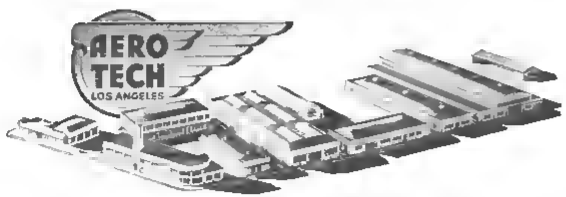
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Back of the winged weapons of this war in the air... back of the men who man them... are the men who man the weapons of aircraft design and production. Our victories through air power start with the highly trained engineers and mechanics in the production army. Aero Tech has sent almost 4500 such men into the battle of production... men equipped with broad, practical knowledge of their respective fields of endeavor, and with advance experience in using the tools of their trades. Aero Tech is proud that its long years of building up one of the largest and best equipped aeronautical schools in the world are being rewarded in significant service to our nation in this time of need.

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C.A.A. APPROVED for Aircraft and Engine Mechanics Training
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Alloy War-Steel reports for its physical

OFM Photo by Palmer, in an Allegheny Ludlum Plant

TESTING is an integral part of production at Allegheny Ludlum mills. Thousands of dollars worth of amazingly accurate machinery are on the job in each mill, testing tensile strength, elastic limit, elongation and reduction of area—all the essential properties of each stainless grade—before it is shipped out for war production.

But after shipping, what? This Allegheny Stainless, made and tested to such rigid exactness, is a war material of the most vital sort. Every alloy in it stands high on the critical list. Is it being used as carefully as it was made? Are fabricators getting the maximum number of products and parts from every ton, with the least possible loss in rejects, spoilage and other forms of waste? Are high alloys being used in places where lower alloys would suffice?

We urge you to check or re-check these questions against your own use of Allegheny Stainless, as a matter of vital concern in national conservation of materials. Especially do so if your plant, as a converted industry, is relatively un-used to the handling of stainless steel.

We'll help you in any way possible to make the nation's supply of metals and alloys go farther. Technical information, fabricating data, or the personal assistance of our Technical Staff, are yours on request.

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Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

★ ★ ★

Just by KEEPING WELL
You can help win this war!



FOLLOW THESE 5 RULES

Memorize these five keys to good health Follow them carefully — for your own welfare and for victory

1. Eat Right

Milk, butter, eggs, fish, meat, cheese beans and peas, fruit, green leafy vegetables and the yellow ones, whole-grain or enriched cereals and bread—these are the *key* foods Eat plenty of them *And* eat 3 meals a day!

2. Get Your Rest

Regularity counts most You can't catch up on *lost* sleep or *missed* relaxation! Try to keep on a regular schedule every day Take it easy for a little while after lunch and dinner Go to bed on time, get up on time

3. See Your Doctor Once a Year

You have your *car* checked and serviced every thousand miles Do as much for your body Physicians can *prevent* many diseases and illnesses for both children and grown-ups nowadays Give your doctor a chance *now* BEFORE you get sick Go to see *him*

4 Keep Clean

Plenty of baths lots of soap Clean hands clothes, houses beds! Get fresh air, sunshine Drink lots of water

5. "Play" Some Each Day

Romp with the family, visit with friends, take walks, play games — or do whatever you like to give your mind and body a change from the daily grind on the job All work and no play makes Jack a dull boy

(Courtesy Institute of Life Insurance)

THIS SPACE CONTRIBUTED BY THE BG CORPORATION

RESPONSIVE AS ALADDIN'S GENIE

Airpower will win the war and control the peace Proud we are therefore to serve United Nations' Air Forces with **ISOdraulic* control systems and equipment with which aircraft instantly respond as if by magic to the fingertip instructions of the pilot Multi-engine control technique simplified thru precise response irrespective of temperature, altitude, vibration or system pressure fluctuations

Illustrated—ADEL slave unit valve rival of Aladdin's genie in accurate obedience to the pilot's every wish Unique secret part of ADEL **ISOdraulic* Control Systems Tested from —80° F to +200° F (*T M Registered)

ADEL

BURBANK CALIFORNIA

Engineering Offices Dallas Texas Detroit Mich Huntington W Va Hagerstown Md Toronto Canada

"STANDARD EQUIPMENT" IN PEACE IS ONE THING



BUT TODAY, almost before a test pilot can take a new fighter plane "upstairs," its design is changed. Faster engines are constantly being demanded — and delivered. . . tougher fabricating materials developed.

Yet the warplane whose wings are still blueprint paper has one thing in common with aircraft designs that have gone before — the Torrington Needle Bearing.

Changed-over to production-for-war, the Needle Bearing is once more proving its adaptability, in applications where its unique advantages mean more than ever. Low coefficient of friction, for example, makes it especially well-suited to manual control operations in fighter planes, assuring smooth, steady performance.

Not only in aircraft production but throughout industry, every feature of the Needle Bearing is filling some vital wartime need. Its small size is saving space and critical materials. . . its remarkable ease of installation cutting assembly time, its design eliminating extra parts and assembly steps, its high capacity and efficient lubrication reducing the need for replacement or maintenance attention in service.

Small wonder that the Torrington Needle Bearing has become standard equipment, too, in America's production-for-Victory program.

FOR INFORMATION concerning capacities and sizes send for Catalog No. 114. Or consult a Torrington engineer. He is well qualified in adapting the Needle Bearing's unique advantages to specific problems

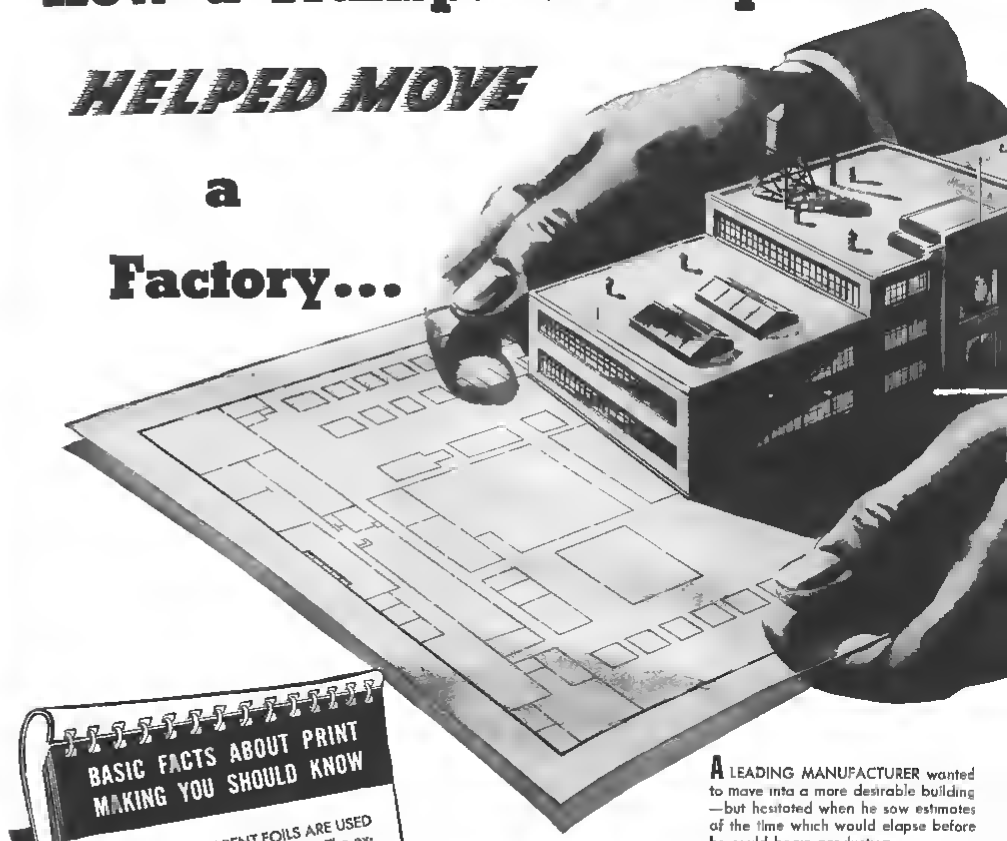
THE TORRINGTON COMPANY
TORRINGTON, CONN., U.S.A. • Est. 1866
Makers of Needle and Ball Bearings
New York · Boston · Philadelphia · Detroit
Cleveland · Seattle · Chicago · Los Angeles
San Francisco · Toronto · London, England

TORRINGTON NEEDLE BEARING

Every feature fills a wartime need

How a Transparent Duplicate

HELPED MOVE a Factory...





A LEADING MANUFACTURER wanted to move into a more desirable building—but hesitated when he saw estimates of the time which would elapse before he could begin production.

Ozalid then showed how five hundred hours could be saved in drafting time alone! First, instead of making multiple drawings of the master floor plans—Ozalid transparent duplicates were quickly made. The draftsman then added—direct to the duplicates—the plans for machinery layout, ventilating and heating, transmission and beltings, electrical and plumbing connections, etc. These duplicates were used to produce the desired number of work prints. Thus, in changing over . . . time and labor were saved.

Today, many manufacturers are reorganizing factories and assembly lines . . . making frequent changes in product design. And the Ozalid Process is giving them a "head start" in vital war production. An Ozalid whiteprint machine turns out standard and transparent prints in two quick steps—Exposure and Dry Development . . . without the wasteful tie-ups which are a part of "wet" developing methods. And Ozalid's wide variety of sensitized materials allow you to cut drafting time . . . speed the making of corrections . . . turn out whiteprints which will have the most "back bone" in the busy shop or sun-baked field.

Write for new catalog. See how the Ozalid Process can help you!

OZALID PRODUCTS DIVISION
GENERAL ANILINE & FILM CORPORATION
JOHNSON CITY, N.Y.
Ozalid in Canada — HUGHES OWENS CO. LTD., Montreal

Air Carrier Operators:—

MEET THE NOV. 1 DEADLINE

FOR A

Flashing Tail Light



DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION
WASHINGTON

March 16 1942

SAFETY REGULATIONS BULLETIN NO. 192

SUBJECT: Additional Air Carrier Position Lights

PREPARED BY: Aircraft Engineering Division

You have previously been informed about our desire to provide better position lighting for air carrier aircraft, particularly as it relates to rendering them more conspicuous to other air traffic. In connection with our program to accomplish this purpose when a single red light and a single white light are used as position lights on air carrier aircraft, we have realized that the effective use of these lights would be greatly increased if they were flashing lights. Accordingly, we have been conducting a program to develop a flashing light unit of improved performance and reliability by means of a thorough test program.

After it had been decided to display the flashing red and white tail lights, revised rules pertaining to the position light regulations were prepared and by order of the Civil Aeronautics Board on March 9, 1942, were made effective as of July 1, 1942. A conference covering these rules was held in Washington on March 6, 1942, with representatives of the various manufacturers of aircraft lighting equipment. Information concerning the availability of suitable flashing units was discussed at this conference. Also present at this conference were representatives of the Bureau of Aeronautics, Navy Department, and the Army Air Forces. Subsequent to this conference, a conference covering these rules was held in Washington on March 6, 1942, with representatives of the various manufacturers of aircraft lighting equipment. Information concerning the availability of suitable flashing units was discussed at this conference. Also present at this conference were representatives of the Bureau of Aeronautics, Navy Department, and the Army Air Forces.

Above is excerpt from C.A.A. Safety Regulation Release No. 192
Belleville 4, N. J.

. . . WITH THIS C. A. A. APPROVED FLASHER MECHANISM FOR AIR CARRIER AIRCRAFT . . .

Accuracy of flashing characteristics of Wallace & Tiernan tail light flashers is held constant by a governor-controlled motor. This unit requires a very small amount of energy for operation and is capable of performing for long periods of time without appreciable wear of the moving parts. It will function in any position, has no objectionable radio interference, is temperature compensated and has successfully met all C.A.A. requirements, including those for vibration.

Weighing only 2 pounds, 14 ounces and measuring just 4¾ x 9½ inches when mounted, this flasher mechanism gives quick positive make and break of contacts, with capacity for handling as many as three 32 candlepower lamps on each circuit should C.A.A. regulations ultimately require the additional flashing of wing tip lights. For complete information write for Technical Publication 234.

INSTALLATION

Three simple operations

1. Socket permanently fastened to any horizontal member by screws and elastic stop nuts furnished with each unit.
2. Fine positive spring compression fairlies clamp mechanism to retaining socket.
3. Wiring is through standard aircraft AN connector.

REPLACEMENT

Replacement requires only two quick operations.

This unit has been basically proved through long experience in the marine field as an aid to navigation and with minor modifications is now being produced to meet the specific requirements of C.A.A. regulations as they apply to air carrier aircraft.

WALLACE & TIERNAN PRODUCTS, Inc.
BELLEVILLE, NEW JERSEY

GETTING THEM IN THE AIR *Faster*



With Parker-Kalon Self-tapping Screws Speeding Production of Equipment and Fittings

Boeing Flying Fortresses in Final Assembly

It can happen – lack of a tiny part can hold up delivery of a 30-ton battle plane! A fast flow of the innumerable parts that go into aircraft is just as important as speedy construction in the plane assembly plant. Helping to speed production of aircraft equipment and fittings is one of the many important war jobs of Parker-Kalon Self-tapping Screws.

They're "doing a job" for scores of makers of all manner of aircraft parts and equipment by simplifying and speeding up fastenings. They eliminate the tapping that goes with machine screws . . . they cut out the handling of lock washers . . . they make fastenings quicker than with bolts and nuts or rivets, in hard-to-get-at places . . . they make fastenings to plastics without the use of inserts.

And every P-K Screw goes in easily and quickly – makes a strong fastening. The Parker-Kalon Quality-Control Laboratory guards against "doubtful screws" – screws that look all right but some of which fail to work right.

No matter what material you're working with – sheet metal, heavy steel, die castings or plastics – there's a type of Parker-Kalon Self-tapping Screw – thread cutting or thread-forming – that will help you save time on your assembly job. Send assembly details by mail for recommendations and samples, or ask for a Parker-Kalon Assembly Engineer to call at your plant. Parker-Kalon Corp., 192 Varick St., New York, N. Y.

CHECK OVER YOUR ASSEMBLY METHOD

Are you sure you're getting all the speed you can? There's a good chance that the right type of P-K Screw in the right place will help you.

On request, a Parker-Kalon Assembly Engineer will work with you. Or, if you prefer, send a description of your fastening jobs for unbiased recommendations and samples for a trial. There's no obligation.



SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS
Give the Green Light to War Assemblies



America's only Radial Air-cooled Diesel Engine

Guibersan's present world leadership in the field af radial diesel engineering began more than thirteen years ago when Guiberson engi neers developed the world's anly high speed air coaled radial diesel engine Ten years ago the first Guibersan-powered plane toak ta the air and the first A.T C certificate for the Guiber-son radial diesel engine was granted Six years aga the first Guiberson radial diesel toak its ploce in the tanks af our first armored force. Todoy the Guiberson radial diesel engine pro-vides dependable, law-cast, fire-safe power that will help America win the edge that is needed for victory—and it is the power plant that will win leadership for America in the field af past-war transpartatian an land, on sea, and in the air!

Established 1919

Guiberson U.S.A.

GUIBERSON DIESEL ENGINE COMPANY
Dallas, Texas

THE GUIBERSON CORPORATION
Aircraft and Heater Division

EQUIPMENT AVAILABLE FOR MAKING TESTS OF AIRCRAFT

(Partial list)

VIBRATIONS:
Production of
Bernhardt Mechanical Oscillators OS1 OS4
Johnson Vibration Machine

VIBRATIONS:
Measurement of
Vibration Velocity Unit
Sound Level Meter
Vibration Pick up
Balancing Equipment

STRAINS:
Measurement of
Electro-Magnetic
Carbon Resistor
Scratch & Wire Resistance Strain Gages

TIME, SPACE and MOVEMENT:
Recording
Chronograph
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Specializing in "ENGINEERING THINGS TO COME"

Wherever instruments can assist in determining the performance of equipment that will be subject to maximum or service loads and vibrations, Waugh Laboratories can be of extraordinary service

Waugh Laboratories makes available a wide range of testing instruments and machines for the determination and analysis of stresses, vibrations and accelerations

Equipment may be purchased or rented. Our engineering field service and our laboratory facilities are available for specific tests or developments

NEREUS H. ROY *Director*

WAUGH LABORATORIES A Division of Waugh Equipment Company, 420 Lexington Ave., N. Y. C. · Pacific Coast Branch 180 East California St., Pasadena, Cal

GLOWELD PASSES RIGID TESTS WITH *High Honors*



Strength and Corrosion Resistance Established For *New* GLOBE Welded Stainless Steel Tubes...

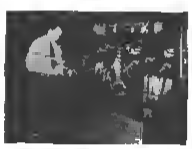
The ability of Gloweld Stainless Steel Tubes to pass exhaustive laboratory tests for corrosion resistance—tensile strength and bursting resistance—... is important news to the chemical and process industries, food industries, pulp and paper, oil and other industries where these performance factors are vital.

These successful tests, coupled with Gloweld's comparatively lower cost, forecast wider applications for stainless steel tubing.

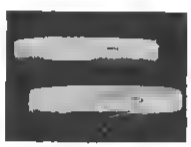
Gloweld is a development of Globe Steel Tubes Co., pioneer manufacturer of stainless steel tubing. It is produced by a closely controlled electric welding process resulting in very little "flash" at the weld, which is removed in a subsequent operation.

Gloweld is available in a wide range of diameters, and wall sizes, in practically all stainless steel analyses. Write for full information.

GLOBE STEEL TUBES CO.
Milwaukee, Wisconsin



Standard laboratory tests, with boiling 65% Nitric Acid with Nitric and Sulphuric Acids, and by exposure to salt spray and the Strauss Test, have established the corrosion resistance of Gloweld.



Gloweld Tubes were subjected to pressure until they burst. The weld in every case was as strong as the strip steel.

★ STAINLESS TUBES
★ BOILER TUBES
GLOBE TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL *Tubes*

Read 'em and Weep

(for the Japs – if you can)

The Bomber That Broke the Japs' Hearts at Midway



MARTIN BOMBERS SINK JAP CRUISER

Direct Hit Scared On Plane Carrier In Aleutian Island Battle

United States torpedo planes sank a Japanese cruiser and scored a direct hit on an aircraft carrier of the main Japanese [illegible] force attacking the Aleutian Islands, it was [illegible] Martin B-26's as torpedo

Allies Compare Planes:

Martin Bombers Best Against Foe

By HAROLD GUARO
United Press Staff Correspondent.

SOMEWHERE IN AUSTRALIA, Aug. 7.—Eight months of war have taught the Allies that pre-Pearl Harbor conceptions of the Japanese as poor fliers using inferior planes were wrong.

Any American pilot will tell you that the Japanese flier knows the score and that the improved Zero plane is one of the world's finest fighters.

The fact that Allied planes have proved a match for Zeroes on the 2,000-mile front north of Australia is a tribute to their pilots' flying ability.

MARTIN B-26 BEST

The American mace fighters that go against the Zeros are the Bell Airacobra and the Curtiss Kitty hawk but it is the Martin twin motored Marauder bomber—the B-26—that battle reports show to be the most effective.

American pilots like their new planes but they frequently express a wish that they had a little more of the Zero's all around capabilities especially its ability to climb fast and get on top in combat and its wide operational range.

Every pilot tried to get above his opponent in a dogfight and that's where the Japanese plane seems to have the edge. I recall an occasion in which several pilots told of our pounding a lone Zero. They fired until they had it lagged. One said: 'And then what does he do? He goes straight up and leaves us there."

embodied in its construction. The engine is of the Pratt & Whitney type. German and American ideas are noted in the instrument panel arrangements.

Many structural features are those of the British Hurricane and the armament is much like that of British fighters.

It was tested for years against the Chinese, for the Japanese apparently used China as a laboratory for the machines they later used against the United Nations.

FARES BETTER

A study of Army communiques shows that the Martin bomber has fared better against the Japanese than the Airacobras and the Kitty hawks. The Zero can outrace the twin motored heavier Martin, but it can't outgun it and it cannot take the steep dives or fly at low level with the American plane.

Once the B-26 is in the air it can take care of itself and pilots say the Japanese have a healthy respect for it. There have been instances where a B-26 has carried literally two Zeros to pieces and many pilots believe that the best plane to whip the Zero will be one somewhere between the B-26 and the fighters they now are using embodying the best of both

smooth song of power
0 horsepower engines,
es' newest champion
through its paces over
the hands of Uncle
MacDill field.
Martin B-26 medium
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r the Axis and victory
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their crews could
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d have escaped to

filled the skies
of their anti-

their valiant crews did not return to their bases, but the score was 10 man and two $200,000 planes for two Jap carriers, each carrying over 1000 men in its crew and worth several million dollars. And adding to the score, the planes from the enemy carriers, which found no place to roost, went down in the Pacific.

* * *

The B-26's scored again in the battle [illegible] putting an aircraft carrier out of action.

They also struck hard at Cologne in Germany, in the Mediterranean, and in Coral sea, proving that whether the objective is an enemy base on land or a battleship at sea, the medium-size, medium range, but tremendously swift medium bomber, of which the 26 is today's shining example, can blast it at smaller loss than any other weapon.

Brig. Gen. Jimmy Doolittle has let the world know what he thought of the B-26 by using one on various military missions since he led the raid on Tokyo. That particular job was done in Consolidated B-25's which is just about as effective as its sister 26 but not quite as fast. It was General Doolittle who gave MacDill and Tampa their first glimpse of the 26 when he landed here about six weeks ago.

* * *

What makes the B-26 one of the most potent bomber-torpedo planes in the world today? Just a look at it will

Martin
B-26 BOMBER
Builders of Dependable Aircraft Since 1909



SPECIAL FEATURES

Extremely Compact. 18" long 13" wide 12" high Weight—70 pounds Electrically and mechanically balanced, with even weight distribution

Portable. Hand holes for easy carrying

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Accessibility. Top and rear panels easily removable All internal parts within easy reach

Convenient Controls. All controls assembled on one panel

Wide Range. From 0 to 2000 cycles per sec and Galvanometers of different natural frequencies are available

Accessories. Remote control; extra take up reels; extra magazines; galvanometers

Consolidated Portable Recording Oscillograph

THE *Consolidated* Portable Recording Oscillograph offers the advantages of completeness and simplicity of operation and satisfies the most exacting requirements in modern test work.

It is built to the highest precision standards by specialists in the design and construction of scientific instruments.

Consolidated also manufactures a complete line of vibration pick-ups, amplifiers, and related testing equipment.

Ask for new descriptive bulletins.

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Specializing in Vibration & Strain Measurement

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1. Men between the ages of 18 to 35 inclusive, holding a currently effective C. A. A. Airman's Certificate, private grade or higher. **2.** Or, holding a C. A. A. Airman's Certificate, private grade or higher, that has lapsed since January 1, 1941. **3.** Or, a certified statement showing completion of 200 or more glider flights. **4.** Or, if you were a former aviation cadet or aviation student, who has completed at least 50 hours of total flying time, either dual or solo, at any Army, Navy, or other service flying school. *Get in touch with your nearest recruiting office*



LUMARITH Glides with the Winged Commandos

America's Winged Commandos are on their way . . . training in unbiased numbers to fly in fleets of swift gliders . . . spearheads of lightning invasions. And many of these new knights of the air will first sight enemy territory through their glider windows of transparent Aero-Quality Lumarith

More transparent than glass . . . extremely light in weight . . . this super-tough and shatterproof plastic answers military requirements for aircraft. Its impact strength, at all temperatures, is outstanding among plastics.

Aero-Quality Lumarith is impervious to water and has excellent weathering qualities. It resists crazing. It speeds production because it is easy to form—simple curves can be formed without heat.

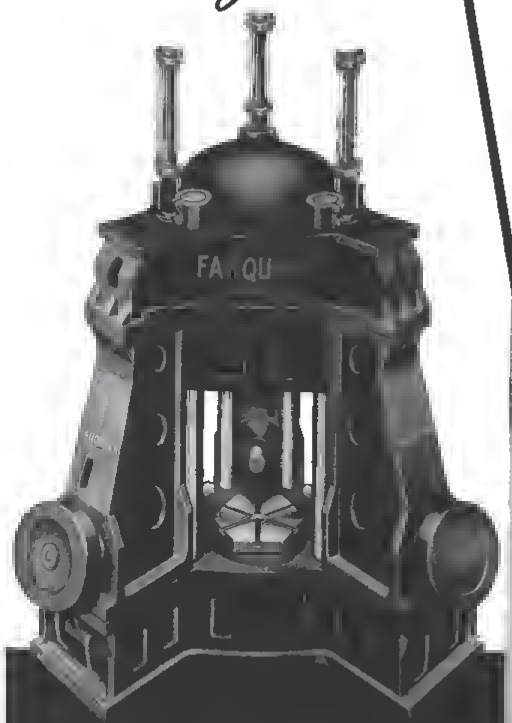
Celanese Celluloid Corporation, 180 Madison Ave., New York City, a division of Celanese Corporation of America Sole Producer of Celluloid® (cellulose nitrate plastics, film base and dopes) Lumarith® (cellulose acetate plastics, film base, moulding, laminating and transparent packaging material and dopes) Lumarith® E. C. (ethyl cellulose moulding materials)—® *Trademarks Reg. U. S. Pat. Off.*

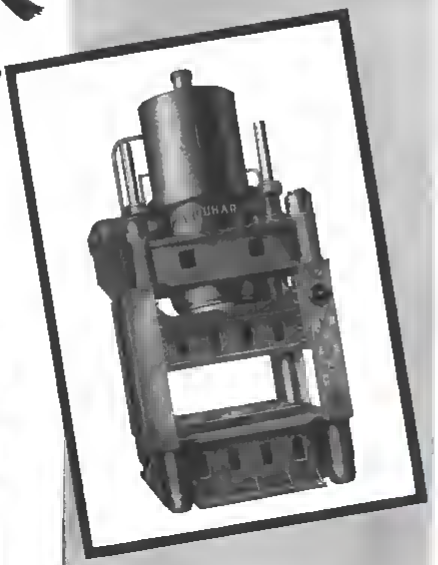
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POWER *to Spare*





Farquhar Self Contained Hydraulic Presses from three tons up, with power to spare for longer life, are built for every conceivable purpose. These two are excellent examples of presses for making aircraft parts On the left is a giant 7200 ton Forging and Extrusion Press Above is a 1500 ton Forming Press.

One of the first to enlist in the war effort, Farquhar started building smokeless powder presses in 1938 and has built over a thousand of them since. (Note Farquhar built smokeless powder presses for the first world war.) Today, in addition to these indispensable units, Farquhar is building presses for finishing operations, shell and cartridge case piercing and drawing, gun and shaft straightening, forging and extrusion, blanking and forming of aircraft parts, flanging and forming at shipyards, and many other operations so needed to help our fighting forces on to victory

FARQUHAR

Self Contained

HYDRAULIC PRESSES

A. B. FARQUHAR CO., Limited

Hydraulic Press Division • YORK, PA.

BETTER WIRE *for* BETTER PLANES!



Wire's Growing Importance is Reflected in New "B" Braid Synthetic

● As planes have grown in size and complexity—as instruments and communications have multiplied—as new needs have arisen for electrical power and control circuits—the importance of insulated wire and cable, designed specifically for aircraft use, has also increased.

Weight factors, abrasion resistance, outer diameters have become more critical as the footage of insulated wire has mounted.

To the solution of this problem, Auto-Lite Sterling engineers have made a definite contribution in the new "B" Braid Synthetic, approved for all low-tension aircraft circuits in sizes from 22 Ga. to 00 Ga.

Its toughness, small OD, and light weight make "B" Braid Synthetic exceptionally desirable as compared to former types of construction. For complete information, write for Auto-Lite Sterling Catalog No. 838

THE ELECTRIC AUTO-LITE COMPANY
Port Huron, Michigan

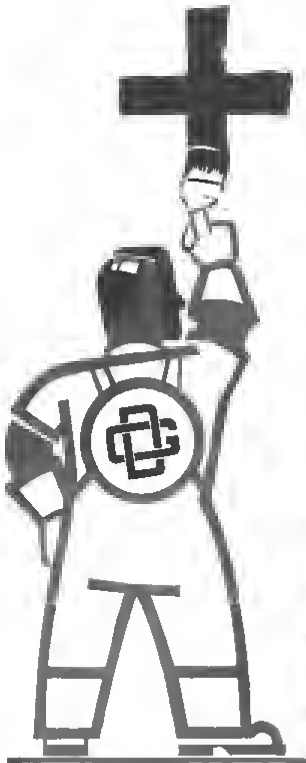


In its 26 great manufacturing divisions, Auto-Lite is producing for America's Armed Forces on Land, Sea and in the Air

AUTO-LITE *Sterling*

AVIATION ELECTRICAL WIRES AND CABLES

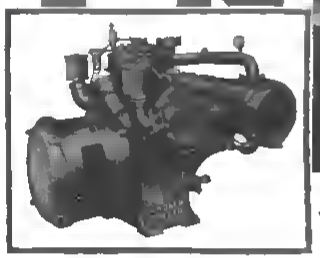
HOW TO GET *Plus Values* FROM AIR

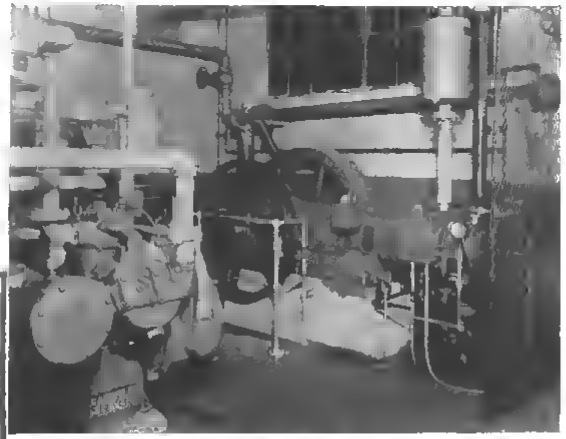


COMPRESSED air is one of the most important sources of power helping to speed aircraft production today. In your plant, your air compressors can be even more versatile—more valuable assistants to you if they meet with these requirements:

1. The full capacity you need—for steady hour-after-hour—shift after-shift operation
2. Regulated capacity—which automatically fits air output to your air needs
3. Carefully designed, ample valve and port areas—and extra large water jackets—which increase and protect compressor efficiency
4. The rugged, dirt-free construction which helps assure low maintenance—and which adds years to the life of the machine

You'll find all of these advantages—plus unusually low horsepower requirements, in the Gardner Denver "RX" Single Stage Horizontal Air Compressor. These compressors are built in capacities from 69 to 1292 cubic feet displacement per minute and may be equipped for any type of drive. For complete specifications, write Gardner-Denver Company, Quincy, Illinois.





Gardner-Denver "WB" Vertical Water cooled Compressors are space saving machines of exceptional compactness and efficiency. They're built in capacities from 142 to 445 cubic feet displacement per minute

GARDNER-DENVER PRODUCTS HELP SPEED VICTORY

GARDNER-DENVER *Since 1859*



HELP FOR THE MAN ON THE MACHINE

Tools for various machining operations, tool shapes, cutting speeds and feeds, cutting compounds, characteristics of the different Aluminum Alloys—all these things are discussed in this new book, "Machining Alcoa Aluminum".

Beginners and experienced machinists will find this book equally valuable. It may contain your key to faster, higher quality production of badly needed war materiel.

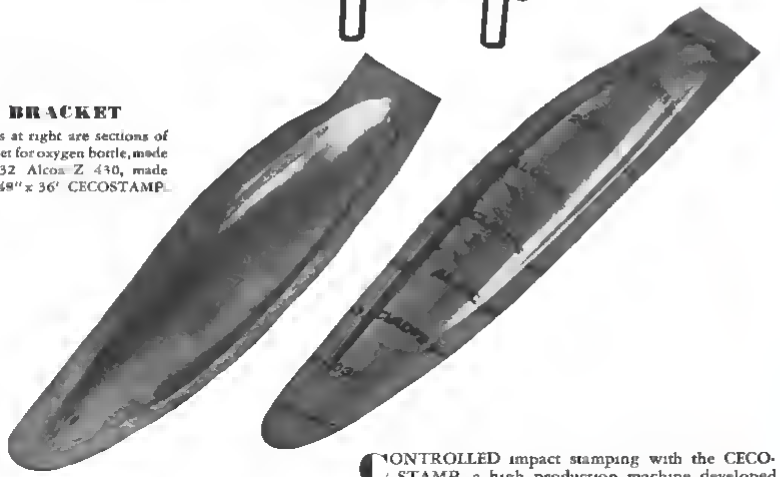
Alcoa engineers continue to be available to assist you in solving new and unusual Aluminum fabricating problems. They'll also gladly counsel with you on your postwar thinking. For this help, and for copies of this new book, "Machining Alcoa Aluminum", write ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh, Pa.

ALCOA ALUMINUM

Cecostampings

BRACKET

Pieces at right are sections of bracket for oxygen bottle, made of .032 Alcoa Z 430, made on a 48" x 36" CECOSTAMP.





THE CECOSTAMP

The modern drop stamp for difficult forming of high strength steel and aluminum alloy sheet metal parts.

CONTROLLED impact stamping with the CECOSTAMP, a high production machine developed by Chambersburg Engineering Co., provides a means of forming difficult metals, such as stainless steel and many aluminum alloys, with fewer operations and greater accuracy. The operator can control, not only the metal flow of the stamping and thus be able to produce shapes without drawing or the reduction of sectional areas, but he can also control the rapidity and power of the successive blows. With this controlled stamping method, the resiliency of metals of low ductility is overcome and they are given a permanent set at a high rate of production with extremely low cost operation.

Write for "Cecostampings", a profusely illustrated booklet, containing details of operation and examples of work produced on Cecostamps

Chambersburg Engineering Co., Chambersburg, Pa

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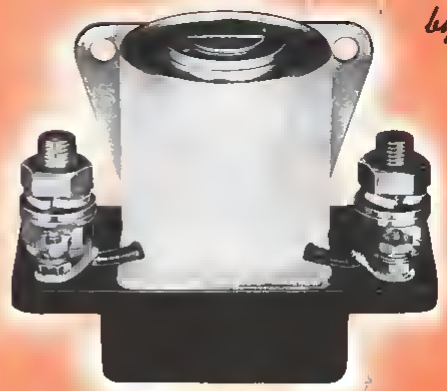
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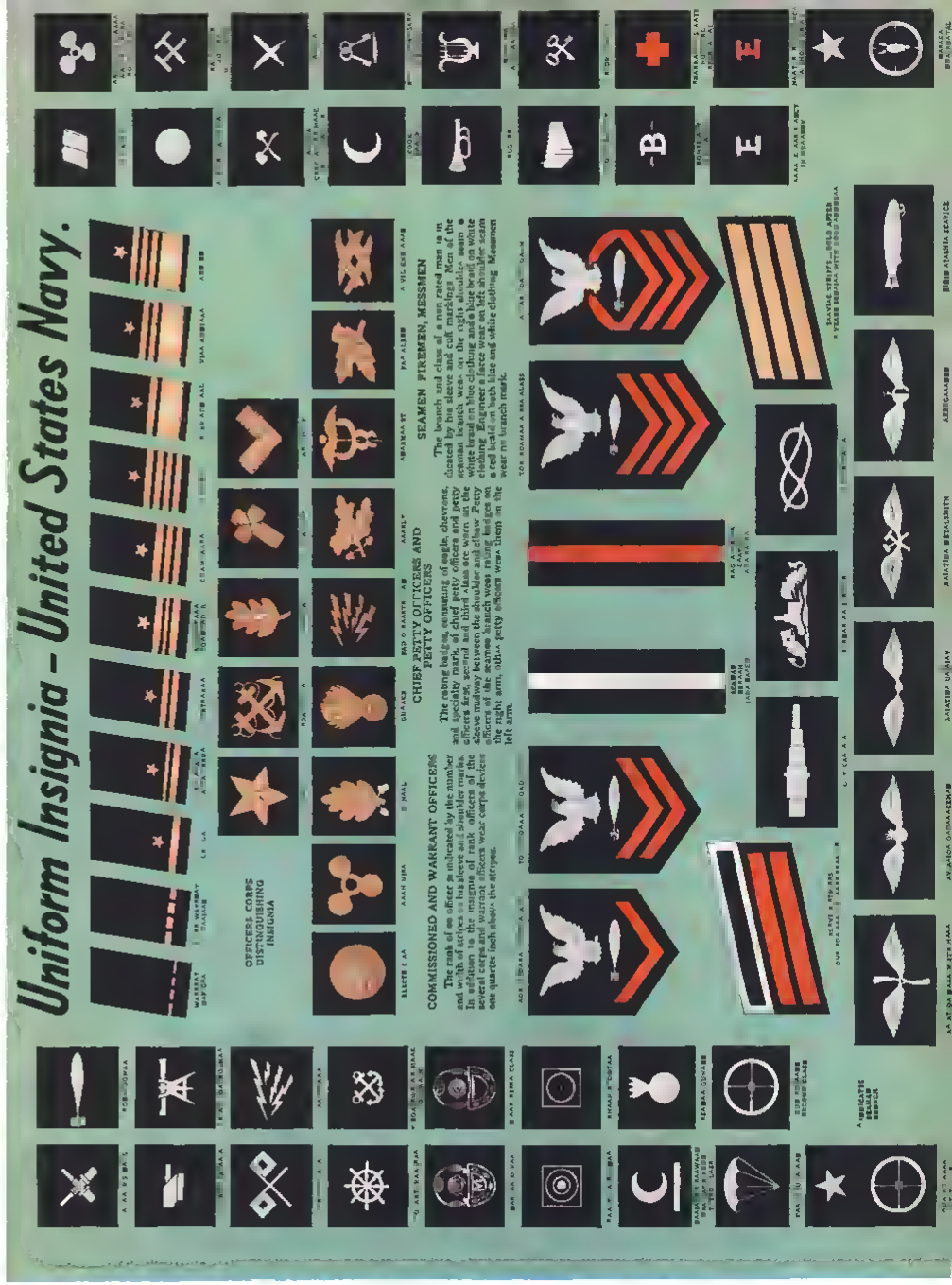


FLOOR-BOARD FREDDIE WOULD ALWAYS SAY,
"IT DON'T HURT IT NONE TO FLY IT THIS WAY."
HE'D GIVE IT THE NEEDLE TO MAXIMUM GOOSE—
THEY NEVER FOUND OUT WHAT FIRST BUSTED LOOSE.

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FROM KUNMING: the commander of the American Volunteer Group cables, "the performance of these liquid-cooled engines has been absolutely amazing — we have destroyed two hundred Japanese planes in the air and on the ground without, to our knowledge, losing a pilot or airplane due to engine failure."

FROM LIBYA: the R. A. F. returned a bullet-riddled Allison that, despite its strafing, got its plane safely home—and on this engine wrote, "one of many others that have been giving magnificent service."

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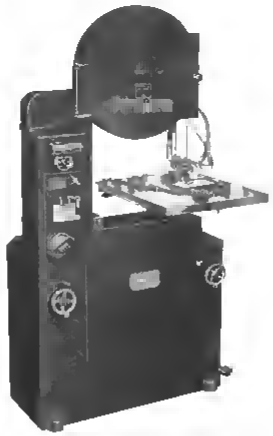


A TANNEWITZ DI-SAW (Big Bertha Model) chain filing inside of die at the plant of DOUGLAS AIRCRAFT CO., Santa Monica, Cal.

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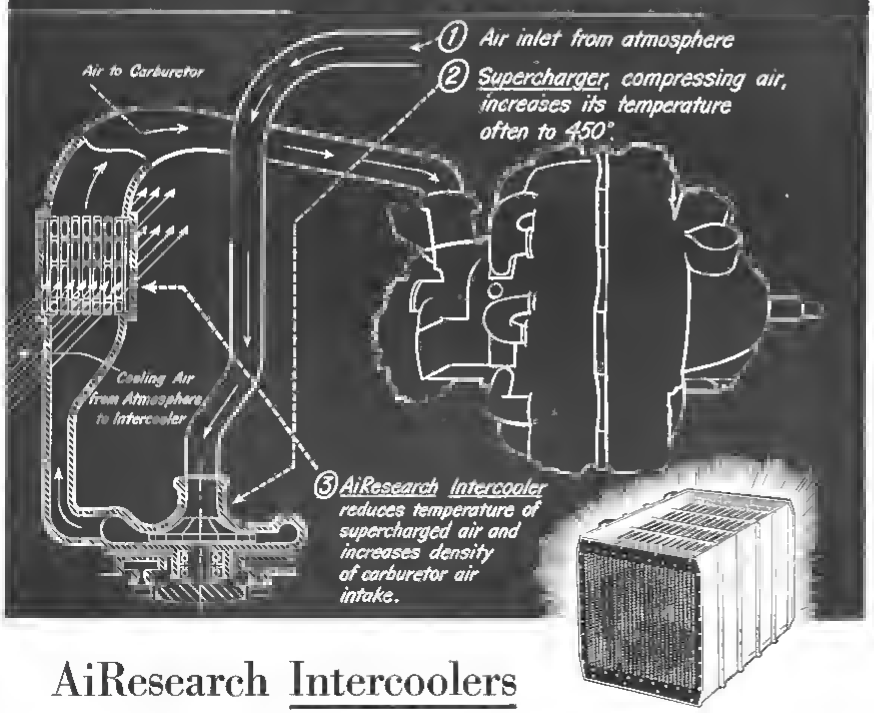
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—giving complete information. Or, if you prefer, a Sunnen Sales Engineer will demonstrate this equipment in your plant on your job.

"To insure interchangeability of parts, we use Sunnen honing on our HYDRO-POWER Valves and Control Bodies."
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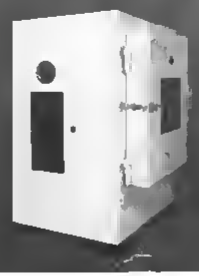
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20,000 feet	2 minutes
30,000 feet	3 minutes
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● In Egypt, that's the daily stint of these giant Flying Fortresses. And delicate instruments on their panels *have to stand the gaff*—from biting cold to scorching heat!

The "TENNEYZPHERE" Chamber is built for exacting tests of instruments that have to undergo just such punishment. These units meet the test requirements of all U. S. Government Agencies: Army Signal Corps, Navy Bureau of Aeronautics, National Advisory Committee for Aeronautics.

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For complete information concerning the many important jobs the "TENNEYZPHERE" Chamber is geared to do to help the great war effort, write Dept A

TENNEY ENGINEERING, INCORPORATED

8 Elm St., Montclair, N. J.



The Chemical Engineer cuts years to months...

Born in the turmoil of the last war, he is shaping a new world with mighty swords and magic plowshares

GERMAN CONSUL-GENERAL HOSSENFELDER, writing from New York on March 3rd, 1916, to von Bethmann Hollweg, chancellor of the Imperial German Government, confidently predicted defeat for the United States because we were totally dependent upon the great chemical industry of Germany. "Americans," he wrote, can never establish such an industry. They have the resources but they lack the necessary science and technology. And, besides the conflicting selfishness of American business renders it impossible."

Even before the ink was dry on Hossenfelder's letter a new figure appeared on the industrial scene—the American chemical engineer. With the help of patient, but progressive and venturesome capital, he laid the foundations for the largest and most resourceful chemical industry in the world.

Today he is an all important figure. For we are fighting a chemical war, even though the emphasis that is placed on planes, tanks, ships, guns and other armament tends to obscure that fact. And this chemical engineer is waging war for us on a prodigious scale. Bombers carry more tons of more deadly explosives because he has developed stronger and lighter alloys and more efficient fuels. Tanks are better armored and wield heavier blows because of products and processes born in chemical laboratories. Ships are welded together by new metallurgical techniques that save precious months over older processes. Gun barrels that are made in minutes instead of hours shoot farther and faster because of better ammunition.

And quantity keeps pace with quality. By mid-year of 1942, explosives were being produced in newly constructed plants twelve times faster than a year ago. Smokeless powder output has been doubled since December. Five times as much TNT was being made in July as in the months preceding Pearl Harbor. One single new plant produces more of this high explosive than did the entire pre-war industry—and several of these plants already are in production.

By what Major General William N. Porter, Chief of the Chemical Warfare Service, calls a "miracle of production," the sort of incendiary bombs that General Doolittle's lads showered on Tokyo were rolling out of our plants within a few weeks after we got into the war. As General Porter puts it, "they were rolling not by hundreds or even thousands, but by the millions." That record he has cited as a tribute to the "ingenuity, industriousness and patriotism" of the American chemical industries.

Yet the General agrees that we have only started to produce in the tremendous volumes that will shortly make Germany, Italy and Japan "revolve on their boasted Axis." Our newest plants are just coming into production. They face no limiting shortages of materials for, in the main, our chemical industry draws its strength from coal, salt, sulphur, limestone, oil, natural gas, coal tar, air and water—all available in abundance.

We have heard little about the use of poison gas by our enemies. It may be that good reasons for this are stored away in our well stocked chemical arsenals. American chemical manufacturers have worked hard and long with our armed forces so that if the time ever comes to make good on the President's warning of retaliation, America will be more than ready.

And defense against gas has not been overlooked. Every soldier is equipped with a most efficient type of gas mask, developed through twenty-five years of intensive research. The Chemical Warfare Service already is manufacturing millions of masks for distribution to civilians. Let us hope we may never have to use them. But if we must, we need have little fear of any gas or secret chemical.

This gas mask program has been made possible by a literal metamorphosis of production facilities, as peacetime industries have been converted to war purposes. A lumber company, for example, is making activated carbon from sawdust. Novelty manufacturers of rubber goods are turning out valves and assembling other parts. Former manufacturers of shirts, swim suits, shoes and beds have converted their facilities and are contributing their share. More than eleven hundred contractors and two hundred and fifty sub-contractors are supplying their full quotas of chemical warfare materials. And production is right up to schedule.

But the bulk of the war job of our chemical industries has to do with items other than weapons and

ammunition The German Consul General, in that 1916 report to Berlin, said that many American industries were in a critical condition because of the scarcity of German chemicals He related in particular that "the cries for help from the world of physicians are becoming louder and louder and more and more insistent." Thanks to our chemical industries this cry no longer is heard Even though we are again cut off from quinine, camphor and some other strategic medicinals, our homes and hospitals are adequately supplied with synthetic products Most of these are better and cheaper than the natural materials The same sulfa drugs that have saved so many civilian lives in recent years have gone to war, with the result that deaths from infection at Pearl Harbor and Bataan are reported as surprisingly low In this war we suffer no shortages of iodine and potash Pioneering research in the field of vitamins has led to new industries that are contributing to health and better nutrition

Those new uniforms the soldiers are wearing are of better quality and will last longer than the shoddy, ill-fitting outfits of 1918—thanks to sunfast dyes and new man made products And in the field of fabrics nylon and the new rayons have gone to war in parachutes and super-strong cords for tank treads and tires

* * * * *

And that brings up the question that 30,000 000 American motorists are asking with ever increasing concern "When, Mr Chemical Engineer, are you going to give us a set of new tires for the old family bus?"

That, I am told is just what the chemical engineers have set about to do on a scale that is difficult to comprehend In the words of Raymond Clapper the columnist, "the synthetic rubber program for this year and the next is the biggest job of chemical engineering ever undertaken in the world" A billion dollar industry is being built at record speed to make almost a million tons a year of chemical rubber to serve our war needs and those of our allies This cannot be accomplished overnight Many months are required to design and fabricate complex equipment, much of which must be made from corrosion-resisting metals and alloys We shall be lucky if a tenth of the desired capacity is in continuous production this year and even more lucky if by the end of next year, the new industry should be turning out synthetic rubber at a rate of 875 000 tons—using both petroleum and grain as raw materials.

All this, of course must go for essential military uses but there is reason to believe that in the laboratory and pilot plant stages we have some promising substitutes and stop-gap materials that may tide us over until the big program starts rolling

The present prospect of real success is possible only because of the cooperation of the chemical, rubber and petroleum industries Individual firms and entire industries have set aside their normal desires and selfish interests to pool their patents, share their research and engineering developments for the common good Synthetic rubber is here to stay as the basis for a great post war industry no doubt as to that lingers in the minds of the men who have seen many other natural products—indigo, alizarine, camphor, vanillin—all eventually fall before the ingenuity of the chemical industry

* * * * *

In the coming peace to which we look forward hopefully we shall find a new world full of new materials, new conveniences new jobs, new opportunities, all stemming out of the present day work of the chemical engineer The same tough, transparent plastics that now make noses for bombers will give us new frameless windows for our homes and automobiles With capacity to produce at least 2½ billion pounds of aluminum, which is five or six times pre war production, and a magnesium capacity 50 or 60 times the pre-war figure, many new uses will develop for these structural materials of great strength and amazing lightness Almost anything that flies, runs moves or otherwise is motive, will have a place for them New fibers such as nylon and vinyon had scarcely got started before they were put to war use Once the war is over they will be with us in greater abundance and at lower cost for a variety of uses so vast and so diverse that we can scarcely imagine them.

And the chemical engineer continues to create and to invent He meets the challenge of scarcities and shortages with ever new "substitutes" that excel their originals Even before the war is over he will have placed at our command a hundred new materials which we did not have before His workshop is all industry His contributions are as limitless as are our needs.

But right now his all important job is to help win the war, to fight to a finish the ruthless and resourceful enemies that are devoting all their science and technology to bring about our defeat So as we take stock of our assets in this desperate struggle, we count among the first the proved resourcefulness of the research minded chemical engineers we now have mobilized to help us fight this chemical war

James H. McGraw Jr.

President, McGraw-Hill Publishing Company, Inc.

This is the fourth of a series of editorials appearing monthly in all McGraw-Hill publications reaching more than one and one half million readers

To the Critics of American Airplanes

A SHORT TIME AGO a very young man wearing the wings of the Army Air Forces on his uniform and a troubled look on his face came to our office for advice He was just about to be assigned to a combat squadron He had been reading what the pseudo-experts say about the airplanes he was about to fly. He had misgivings but he had no fear. All he asked was to know the truth so he could make a sound appraisal of his chances under fire Here are some of the things we told him to correct the impressions he had received from the writings of professional scandal-mongers, who seem to be unable or unwilling to read the daily combat records of our aircraft which are the best evidence of their value

Type for type and purpose for purpose we have no apologies to make for any of our flying equipment. Our best engineering brains are working day and night to retain our leadership in the quality of our airplanes.

Aircraft design is one of the most complex branches of engineering Its complexity is inherent because the designer must draw on almost all of the sciences and some of the arts in his eternal battle against weight and overweight Each of the thousands of individual parts of an airplane must be stress analyzed, weighed and balanced with thoughtful care to determine how it can do its job and still keep down its weight Metallurgy, chemistry, physics, mechanics and mathematics must be always at the finger tips of the structural designer Fuselage form, position of engines, wings, tails, surfaces and landing gear and the mutual interaction of all of these elements are but a few of the critical design factors

Improvements in fuel technology and solutions of the problems of lubrication throughout the relentless temperature range from white heat to the sub-zero of the substratosphere must go hand in hand with the design of engines of ever increasing power and lightness, for all of the efforts of the airplane designer are limited by horsepower available Available horsepower may be used for speed and climb and range or load carrying in the proportions desired But if an excess of one element is required, the others must be sacrificed

When the ideal performance compromise for a given purpose has been worked out, a full size plane is built and then begins a long intensive period of test flying of the prototype. Not until most of the changes dictated by flight test are made is it safe to begin tooling up for quantity production And it is highly important that the tooling be made sufficiently flexible to accommodate the continuous design change of an ever improving product

It is small wonder then that the period between conception and quantity production of a new type of aircraft before the war was normally about seven years. The same period of time for development was necessary in Germany, Italy, Russia, Poland or Czechoslovakia. Human brain capacities are about the same regardless of the color, creed, or language of their bearers. The war has accelerated the whole procedure of design, development and production engineering and this gives rise to a new danger We must not compromise with the completeness of our development work any more than with the quality of the manufactured product

When war clouds gathered all around America it was simple logic to build as many as possible of the planes available as quickly as possible but at the same time provide production facilities so flexible that new designs could be utilized as soon as they had passed through their long development cycles. The long range bombers we are producing in such encouraging quantities were designed in the early 'thirties. Bigger and better ones were designed a little later They will be produced in quantity a little later Much bigger bombers were designed in the late 'thirties. They will be produced in due course but we can't sit back idly while we are at war and wait until they are ready for production Even if we could they would be obsolete compared with some of the designs now at the blueprint stage The same is true of fighters, cargo carriers and everything that flies We have nothing to fear until the day comes when we run out of new and better designs for future assembly lines

We must not be too hasty in declaring a plane obsolete There may be a greater use for it than we are able to foresee Our enemies are still building obsolete Messerschmitts at the rate of several hundreds a month The Junkers JU-57, designed more than a decade ago, is still in substantial production.

In comparing airplane types we must remember that American airplanes were designed to defend America, British planes were designed to defend Britain and German planes were designed to defend Germany. None of the strategists of any of the European nations foresaw the character of this global war Neither did our strategists and designers foresee the need for us to fight in a theater as European as that of Western Europe Both the British and the Germans failed to foresee the need for long range bombers Now both are racing to produce them and the RAF is busy blasting the German factories where they are built.

(Turn to next page)

Our defense problem was different. We knew not where lightning would strike between Alaska and Panama, and we had only one Navy for two oceans. So our designers created fast bombers with sufficient range to go where they were needed in a hurry, carrying supplies, protective armament and a reasonable load of bombs. The turbosupercharger, with its marvelous metallurgy, made it possible for these ships to carry the air war to the altitude limits of human endurance. There they became stable bombing platforms for the functioning of our very effective bombsight. That is why our B-17's are bombing Germany so effectively today and doing it in daylight with negligible losses. Our B-24's have already distinguished themselves in the long range operations for which they were designed. Detailed comparison of these ships with British bombers since designed for the specific job of bombing Germany from England is found on page 96. But their fighting record speaks more loudly than any figures because a bomber that is able to do its work and return safely to base is as good as a new bomber off the production line. It can be seen from their brief record under fire that these ships are the best of their type in the world today. This whole war effort boils down to a race in which the winner will be the side that can first drop the largest tonnage of well directed bombs on the other's vital sources of supply. This will be done by the planes that make the most trips before they are shot down.

Our medium range bombers of the B-25 and B-26 types have already distinguished themselves by doing many jobs for which they were not designed. The men who conceived the B-25 had no idea that it would be used to bomb Tokio. The Japanese learned much about the vulnerability of our B-26's when they dropped torpedoes in the Aleutians.

Most of our pseudo-experts fail to remember that the single-seat interceptor fighter was a purely British development for a single British purpose—the defense of London in the daytime. Many years ago the strategists of England realized that trouble could come to them from a distance of but twenty miles, which in terms of airplane speeds means less than five minutes notice. To intercept this potential sudden attack, a fighter was needed in which all elements of performance were subordinated to climbing rate and fire power. And so began the long line of development that led to the *Hurricanes* and *Spitfires* of today. These ships and their descendants are and should be the best available weapons for the purpose for which they were designed.

With full credit to the RAF for the development of its brilliant defense of London with these ships in daylight, it must be remembered that, when the Germans switched to night bombing, the single-seater fighters were not able to answer the challenge. It was a much larger twin engine American ship, the old Douglas DB-7 ordered originally by the French, that was impressed into service because of its greater range, endurance, and carrying capacity. A later version of this ship the A-20 is credited with stopping Field Marshal Rommel in his recent advance in Libya.

In America we had no problem comparable to the defense of London. Our boundaries were much wider. It was only logical that the developments of our fighter planes should proceed along other lines. It was natural that our fighters could not do as good a job of something for which they were not intended. That is why it is so ridiculous for columnists to clamor for "the American aircraft industry to build the *Spitfire*." This can be done and British fighters actually have been built in Canada. But it is our strategists, not our columnists who must decide who is to build what and where.

No airplane that reaches the production stage is all good or all bad. A given type may excell another in one or more performance elements or it may be better suited to a special job. But it is illogical to compare it with a ship designed for some other purpose. Our 2,000 hp single engine fighter the Republic P-47, will outperform the lower powered fighters including the new Nazi Focke Wulf 190 with its 1,600 hp engine. Our North American P-51 demonstrated performance over ships powered with the same engine because of its highly efficient laminar flow wing.

Type for type and purpose for purpose our fighters are more ruggedly constructed and carry more ammunition and armament than those of the enemy. One .50 m. calibre machine guns have a higher muzzle velocity and greater penetrative effect than the .30 m. calibre types commonly used abroad.

The 37 mm. automatic cannon built into the nose of the Bell P-39 is the largest yet to be carried aloft. Cannon in use on European airplanes fire a 20 mm. shell. Besides this impressive armament our planes carry protective armor plate and leak proof fuel tanks because we want our pilots to come back and fight again. Obviously this increases the weight of our planes and decreases their performance and maneuverability slightly. But it is certainly better to go to war in a tank that in a pleasure car. And our pilots at the fronts have gone on record in their preference for our policies.

The proof of the pudding is in the eating. Our P-40's have defeated the Japanese *Zeros* in every engagement in which they have taken part. The Grumman *Widcat* has a 3-1 score against hand hosed planes of the Japs. The Bell P-39 has operated against *Zeros* above 30,000 ft. and the Lockheed P-38 has taken them in above 35,000 ft. These facts cannot be laughed off by the gentlemen who criticize our planes so glibly. More facts about our fighters and our bombers are presented in the pages that follow. But even more convincing than these facts are those that can't be told because of the aid that their disclosure would give the enemy.

For more important than specifications and statistics are the actual combat records of our planes in action. As this is written the average ratio of enemy losses to our own is nearly 4 to 1. This means that our planes are nearly four times as effective in combat as those of our enemies. *This is the true measure of superiority of American airplanes.* As long as we can outfight our enemies it would be both criminal and impractical to strip our planes of their protection or reduce their fire power to improve their maneuverability.

This is not a defense of American designers, engineers, or manufacturers. They have established a record which will go down in history as amazing. Least of all, is this an expression of an attitude that our current designs will continue to be adequate to the task. Our current planes are good and adequate weapons for the moment. Tomorrow they will be inadequate. The High Command of our Army and Navy Air Forces know this. Our manufacturers, designers and engineers know this. And as you read this they are bending over their drawing boards, studying designs in the wind tunnels, and working at the flying fields on the new models which will bring complete air supremacy to us. A cheering word, an expression of confidence will do far more to advance their important work than a kick in the pants. When the time comes to criticize we will be the first to call attention to shortcomings and to do it with bare knuckles.

The privilege of free speech and free press for which we are fighting carries with it a simple but solemn obligation—to get the facts straight before they are published—and to refrain from the temptation of disseminating demoralizing gossip for personal gain.

Yeslie E. Neville



The Lockheed P-38 "Lightning" is one of the world's highest performance fighter planes. In production since early 1941 it is now in action over wide areas.

The Truth About Our Fighter Planes

This is not a defense of American fighters; none is needed. Nor is it unqualified praise. But here are the facts which prove beyond reasonable doubt that American fighters, taken as a whole, with their equipment and armament, hold the edge of superiority in aerial combat.

WHILE IT IS TRUE that some American combat planes were deficient in armament at the beginning of the war as compared with some foreign types it is senseless to assume that our air forces and plane manufacturers blithely continued ordering and building inadequately armed airplanes. We were simply in the same position as all of the major powers who were forced to modify their designs and equipment in the light of the lessons learned in actual combat.

In aerial warfare, as in all other forms of warfare, there is a constant jockeying for the part of the contestants to achieve an edge in the line power, efficiency and over all performance of all types of equipment. The balance has rocked back and forth and will continue to do so for the duration.

The *Hurricanes* and *Spitfires* of today are far different aircraft from those which went into service at the beginning of the war—just as different as the P-40E's and P-40F's now rolling off the production line and hurling into the battle are from those originally delivered to our air forces and to the British. The same thing applies to German *Messerschmitts*, Jap *Zeros*, Boeing *Flying Fortresses* and all other aircraft engaged in the war.

As we go to press the United States Navy has just issued a communique concerning operations in the Solomon Islands area of the Pacific as follows:

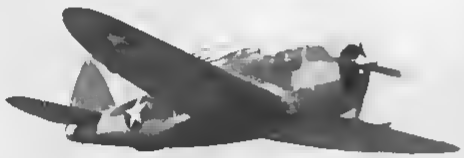
"During the period Sept 25 to Sept 28 inclusive Army Navy and Marine Corps fliers destroyed 42 enemy aircraft and damaged 3 others without combat loss of any United States planes.

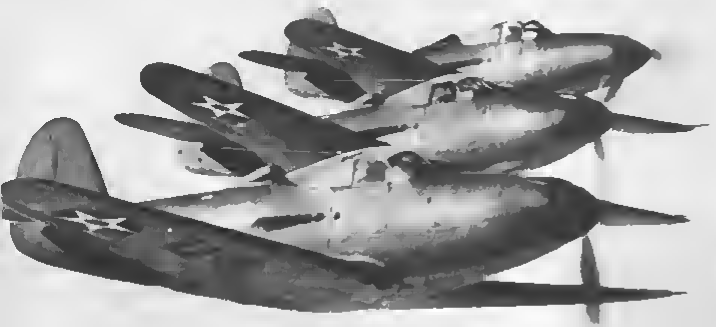
42-0 lover of the Yanks. Boy, what a Series!

During all of early 1942, ample evidence regarding the superiority of American combat planes, both fighters and bombers was accumulating in the form of United Nations War Communiques, which would have prevented so many writers and speakers from going so far astray had they sought all the facts and omitted certain sensational columns from their daily stint of reading material.

When a journalist or any other person makes a public statement in critical times such as these, comparing the performance of an American combat type with that of an allegedly superior pur-





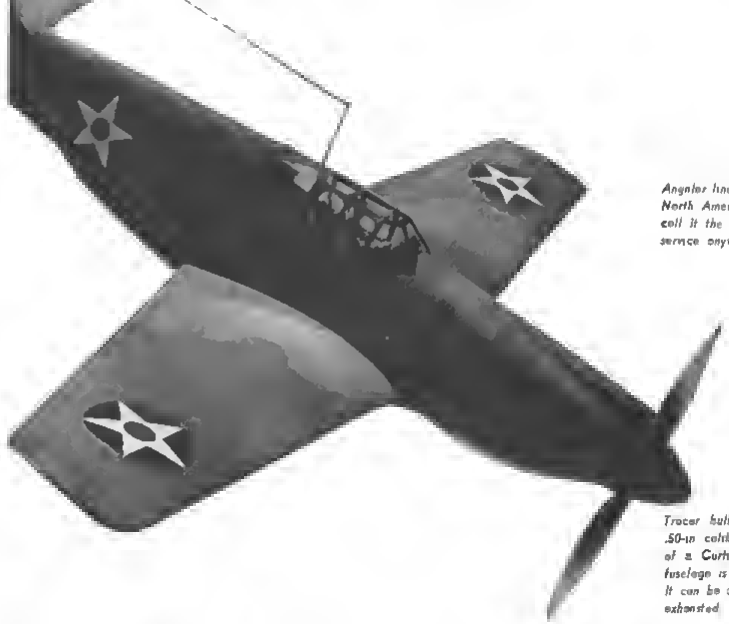


Republic P-47 "Thunderbolts" frequently referred to as the world's No. 1 Fighter Plane. Note the six .50-in caliber machine guns protruding from the leading edge of the wing



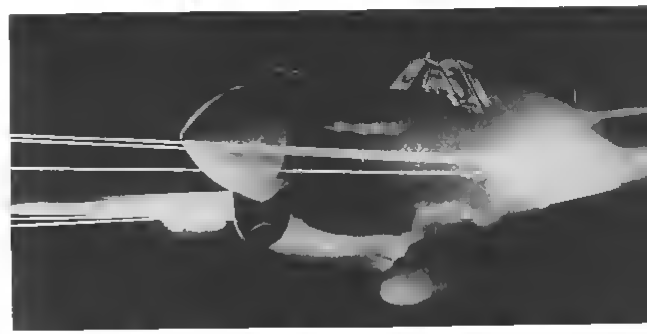
A tight formation of Bell P-39 Airacobras. In addition to machine guns these fighters are equipped with a 37 mm. or 20 mm. automatic cannon which fires through the hollow hub of the propeller

The Vought Sikorsky F4U "Corsair" one of the United States Navy's newer carrier based fighters. Like the "Thunderbolt" it packs 2,000 horses in the nose and plenty of fire power



Angular lines and slender fuselage identify the North American P-51 "Mustang". The British call it the fastest Army cooperation plane in service anywhere

Tracer bullets clearly show the path of six .50-in caliber machine guns in this night photo of a Curtiss P-40 "Warhawk". Beneath the fuselage is a "belly" tank carrying extra fuel. It can be dropped in flight when contents are exhausted



furnamine of a foreign fighting plane, he should be certain to exercise the fairness and honesty to determine whether the performance figures he cites for the American type are gleaned from an old clipping or obsolete directory and perhaps quite different from the actual performance of the particular fighting plane in question. And he should remember that published performance figures do not reflect the latest accomplishments of the design.

American fighter planes have undergone the severest and probably the most concentrate criticism. So to dispel the confusion which exists in the comparisons of type, the individual types will be referred to by their full designations. Of the American fighter planes, the Curtiss P-40 series have been produced in the largest numbers to date. The B and C models are called by the British the *Tomahawk*, the D and E the *Kittyhawk*, and the P-40F the *Warhawk*. Next is the Bell P-39, known as the *Airacobra*. Many thousands of both of these fighters have been produced.

The "Flying Tigers" of the famous American Volunteer Group in China were largely equipped with Curtiss P-40 *Tomahawks*. Up to the time it was disbanded on July 4, 1942, the AVG shot down 218 Jap planes with a loss of only 84 of its own planes. These figures include only verified losses of both sides. Aircraft destroyed on the ground in bombing or strafing attacks were not taken into account.

During the month of August, 1942, the War Department kept tabs on all the aerial engagements in which P-39's and P-40's participated. They downed their adversaries at ratios of 5 to 1 and 3 to 1 respectively.

Lt. Gen. Henry H. Arnold, Commander of the Army Air Forces, reported on Aug. 15, 1942 that 1,110 Army planes had met 1,450 Japanese aircraft in aerial combat and had shot down 190 of the Jap planes with a loss of 104 American aircraft. The answer is obvious—such a record could not have been established had not American airmen and their flying equipment enjoyed a clear and definite superiority over those flown by the Nipponese airmen.

Two other American fighter types which have been delivered to the Navy and Marine air arms are the Grumman F4F *Wildcat* and the Brewster F2A *Buffalo*. After the big Solomon Islands offensive in August when United States Marines occupied the Tulagi area, the Japs attempted a counter offensive and a fierce air and sea battle developed in Aug. 24 when our combined forces intercepted the Japanese. Associated Press correspondent Clark Lee, an eye witness, reported that 96 Jap airplanes were brought down on that day. Navy pilots accounted for 31 enemy planes. Anti-

(*Turn to page* 334)



Analysis of the facts shows that British heavy bombers are not superior to American craft. The Boeing B-17 'Flying Fortress' can fly further, faster and higher and has greater firepower than Britain's newest, the Lancaster. Only category in which the 'Lancaster' has an advantage is in bomb capacity but this is partially offset by the 'Flying Fortress'' precision bombing ability.

The Truth About Our Bombers

For fighting today's wars on all fronts American heavies more than hold their own, our medium and light-bombers are without equal.



Brig. Gen. Ira C. Eaker steps out of a Boeing B-17 on his return from leading American bombers on their first precision daylight raid on Rouen, France, from a base in England. 'Firepower of the Flying Fortresses' was demonstrated on another raid when they were attacked by between 20 and 25 Focke-Wulf 190's, the newest and best pursuit planes in the Nazi Luftwaffe. The score: three Focke-Wulfs definitely, that down with nine more listed as probables.

Press Association

RECENT PRESS REPORTS from England making sweeping statements that American bombers are inferior to Britain's do not stand up under analysis. There is no question that Britain's new heavy bombers are good, for they are. But there can be no question that America's bombers are also good, if not better. Any comparison of bombers must consider one vital fact: that this war is being fought all over the world, and it can be won only by fighting on fronts all over the world—not just over Germany from English bases. And any comparison of bombers must recognize that there is more than one category of bombers necessary to win the war.

Consider first then, the long range four-engine bombers around which most of the recent controversy has centered.

America has two: the Boeing B-17 *Flying Fortress* and the Consolidated B-24 *Liberator*. Britain's line up now includes the Handley Page *Halifax*, the Short *Stirling* and the newest, the Avro *Lancaster*.

What, then, are the charges against the American craft? They appear to be that the B-17 and the B-24 have neither the speed, range, armor, armament or bomb capacity to make them useful for much more than submarine patrol.

A comparison of the B-17 and the *Lancaster*, which the British hail as their best, and a review of the record shows that American planes can more than hold their own. It should be remembered that the B-24—in which Prime Minister Churchill recently flew with an American pilot to Russia and Egypt—is generally comparable in performance to the B-17.

First, there is the matter of speed. Official figures released by the British Air Ministry credit the *Lancaster* with a maximum speed approximating (note that it does not say exceeding) 300 mph. Unfortunately, the Army Air Forces have released no performance figures on the B-17E, the *Flying Fortress* now operating in England. It is therefore, necessary to go back to its prototype, the B-299T. This plane, from models removed from the present craft, had a top speed of 325 mph. Since the B-17b has been developed through four models and is equipped with more powerful engines its speed can, to say the least, be safely put above that of the original job, giving it at the very minimum a 25-mph edge over the *Lancaster*.

Next, take the matter of range. Britain's Air Ministry has released no figures on the *Lancaster*, we have only press reports of approximately 1,000 mi. Assuming that its four Rolls Royce Merlin XX engines, which develop 1,360 hp at 12,250 ft., each consume 50 gals. per hour (a conservative figure), the ship would have a cruising radius of 10 hr. Even if it cruised at 300 mph (which it obviously doesn't, since maximum speed only approximates that figure) the ship would then have a range of 3,000 mi. An operational range of no more than 2,500 mi. is probably a safer figure; say 150 mi. farther each way than that traveled by a string force in the night of Aug. 28-29, when British bombers raided Nuremberg, a distance of some 1,100 mi. each way.

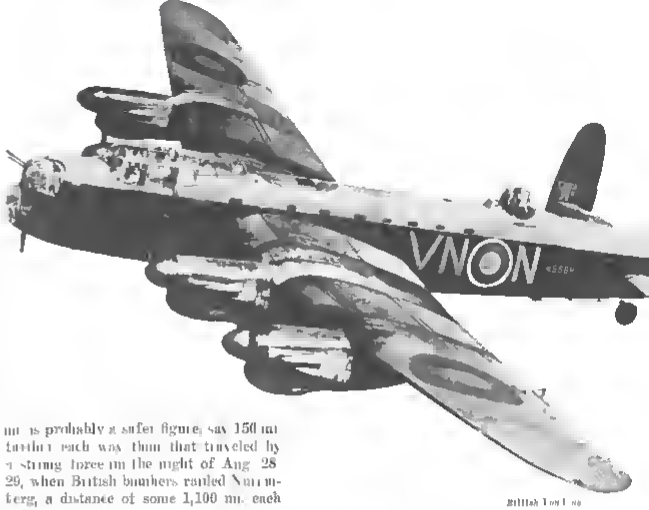
Again there are no official figures available on the range of the B-17E and again it is necessary to go back to the prototype, which had a range of more than 3,000 mi. Obviously, since planes, engines and fuels have been improved, the B-17b has a range well over 3,000 mi.

In the matter of armament—one of the most frequent criticisms of our bombers—American planes more than measure up. The *Lancaster's* firepower consists of ten 0.303 in. Browning machine guns, distributed in the nose, top and bottom of the fuselage and in the tail.

Officially released photographs of the B-17E show at least the following guns: one in the nose, two on top of the fuselage, one on each side of the fuselage (waist guns), two in the bottom turret and two in the tail, a total of nine guns. Since American practice has for some time called for .50 in. calibre guns—nearly two thirds again as large as those in the *Lancaster*—actual firepower is therefore superior in the B-17. Its .50 in. calibre machine guns can throw more shells farther and in a flatter trajectory than the *Lancaster's* guns can.

Little is known of the armor of either the *Lancaster* or the B-17. Here we have only the record, to be discussed later, which gives every evidence that the American planes are better than, or at least as good as, any in the world.

(*Turn to page 328*)



British Official

ABOVE: The Avro 'Lancaster' which the British hail as their best heavy bomber. Its speed is at least 25 mph less than American four-engine planes. While this type of plane is ideal for mass night raids on Germany, planes with qualities found in American heavies are needed to fight on all fronts, a factor absolutely essential to victory . . . LEFT: The Consolidated B-24 'Liberator,' whose performance characteristics are generally comparable to the B-17. It has served admirably on fronts all over the world and 'doubles in brass' as a much needed cargo carrier.



Performance records are the only sound basis for judging an air force and its equipment. The American record is impressive.

GERMAN AIR POWER now is definitely outclassed on the Western fronts. German cities and military establishments are hurt so badly by the Allied attack that Goebbels is promising war-weary Nazis that as soon as the Russians are smashed the Luftwaffe will dish it back to Britain "a thousand to one." This old threat carries less chill now, because the British and Americans know by contact that the stuff is no longer in the air to back it up.

But this fact is no cause for relaxation. If the Germans did manage to prostrate Russia they might rehabilitate their air force; they have the metal, the skill and substantial plant to do it. They are short of aluminum, oil and manpower, but experience shows you can't trust an enemy with a shortage.

It is possible that the Nazis might again give hard battle in the air across the channel, or elsewhere, and our war chiefs are going ahead preparing as if they expected just that.







LEFT A Grumman 'Wildcat' roars off a carrier flight deck to join a late afternoon combat patrol somewhere in the Pacific. RIGHT The men who are directing America's effort for winning the war on (and over) German battlegrounds. Seated left to right: Maj Gen Carl Spaatz commanding AAF in Europe; Lt Gen Dwight Eisenhower commander American forces in Europe and Maj Gen Walter Frank commanding Air Service Command. Standing left to right: Brig Gen Ira Eaker Bomber Command; Brig Gen Frank Hunter Fighter Command; and Brig Gen Robert Candee Ground Air Support Command. TOP Fifty-eight pilots and mechanics of the Brazilian Air Forces flew 19 Fairchild F-24's and 25 PT-19 primary trainers from an Eastern Fairchild plant to Rio de Janeiro completing the largest flyaway delivery yet made to South America and demonstrating Brazil's determination to prosecute the war without delay. Prominent figures in this impressive achievement were left to right: Maj Antonio da Silva Gomes and Maj Joao Mendez de Silva of the Brazilian Aeronautical Commission; Col Armando Arariqboia Air Attache of the Brazilian Embassy in Washington, and Maj Miguel Lempert chief of the Brazilian Aeronautical Commission in Washington.

Meanwhile accumulating Allied air strength is being used prudently but aggressively to shake the foundations of Hitler's 31 essential war production centers. So good does this operation look to the lay citizenry, and to many military aviation men that they advocate putting more materials and man-hours on an air force to beat Germany down with air fire and bombs almost exclusively.

A recent Gallup poll showed 40 percent of the public wants to give Germany the all-air treatment, 49 percent thought other military elements also would have to be used, 11 percent said they didn't know. While it is probable that the wisest people would be found among the 11 percent nevertheless, this is the public's show, it is their money, and they are bound to boo down any act that gets too old and tiresome. It was the public that gave the hook to the Admirals' battleship skit. Who can say

(*Turn to page* 286)

Profit Limitations By Treasury Directive

An informative and broad interpretation of T D 5000, how it controls "cost plus" accounting, and how it affects aviation earnings and securities

By SELIG ALTSCHUL

DESPITE THE DOMINATING influence which is exerted by aviation on the war effort, there is very little popular conception as to the fiscal arrangement governing the relationship between the aviation industry and the federal government.

For all practical purposes, the aircraft builders now have but one customer the U S government. Similarly, the airlines will shortly be devoting the bulk of their operations, under contract, for the same client.

Doing business with the government is no simple matter. While the urgency of the times may have accelerated proceedings, all sorts of formal contracts must be negotiated. In many instances, a letter of intent or some other assurance served as the starting signal on government work.

In its relationship with private industry the government has erected all sorts of safeguards designed to protect the taxpayer from paying excessive prices on all purchases. Congress, seemingly has taken the initiative in enacting legislation towards that end. It remains for another arm of the government—the Treasury Department, however, to enforce this broad directive.

Much is heard us to the constant renegotiation of war contracts. The recent establishment of Price Adjustment Boards in the Army, Navy and Maritime Commission has been responsible in the general impression that no provision previously existed for placing a ceiling on profits. Long before the War and Navy Departments began to issue press releases as to their zeal in protecting the taxpayer's dollar, figures were quietly in operation limiting profits on aircraft contracts. The Act of June 28, 1940, (also referred to as the Vinson-Trammell Act) has passed by Congress' . . . to expedite national defense and for "other purposes." This measure pertained to construction or manufacture of any complete naval vessel or any Army or Navy aircraft. The "other purposes" were chiefly concerned with limiting profits to 8 percent of the contract price of the work performed. All excess profits are to be paid into the Treasury. However, to allow for adjustments, the following definition is advanced—

"... any profit in excess of 8 7 per centum of the cost of performing such contracts, except private contracts made on a cost plus a fixed fee basis, as are completed by the contracting party within the income taxable year shall be considered to be profit in excess of 8 per centum of the total contract prices of such contracts."

This section not only states a broad policy but, on the surface, appears simple enough and it would seem that Congress, with a stroke of the pen has assured four profits while outlawing excessive gains on war work. No clear-cut formula, however, is presented.

It will be noted that while the section states "cost of performing such contracts," no definition is advanced as to what constitutes proper "costs." And here is where the Treasury Department comes in. Faced with the responsibility of administering this act, the Treasury has issued its own set of regulations as to what are properly constituted costs and in general terms has specified allowable and disallowable items. These regulations are incorporated in the now famed T D 5000 which has assumed importance as a factor in affecting aviation profits.

T D 5000 applies not only to aircraft construction for the Army and Navy (both prime contracts and subcontracts), but has also been extended to cover the various relationships now existing between the airlines and the Army Air Forces. Wherever specific provisions or definitions are lacking in any of the individual contracts, T D 5000 becomes the unquestioned criteria.

Despite its importance, T D 5000 and the definitions it encompasses is probably the least understood ruling ever issued by the Treasury Department. The best explanation thus far advanced is the "Principles for Determination of Costs Under Government Contracts"—issued by the War and Navy Departments. Even the explanations are vague in many respects. The interpretations contained in this study, however, are very helpful and warrant careful attention.

Recognized accounting and tax procedures do not necessarily set a pattern for T D 5000. The above mentioned "Principles" clearly state that "whether or not an item of cost is allowable as a deduction in computing federal income taxes is not the criterion whether such item is proper as a part of cost under government contracts." Total cost under a government contract is the "sum of all costs incurred by the contractor incident to and necessary for the performance of the contract and properly chargeable thereto." In other words, the overhead burden if not directly traceable to war work may not be computed as a proper cost item. In effect, this makes for one set of costs for a civilian customer, and another for the government.

For purposes of simplicity, the items of cost that enter into government contracts are classified as follows:

Manufacturing Costs

Direct shop costs:
- Materials and parts
- Direct labor
- Shop engineering expense
- Other direct shop costs

Indirect shop costs
- Supplies and sundry materials
- Indirect labor
- Service and maintenance
- Fixed charges
- Other indirect shop costs

Other Manufacturing Costs
- Amortization of patents, purchased designs etc
- Engineering and development expense

Other Contract Performance Costs

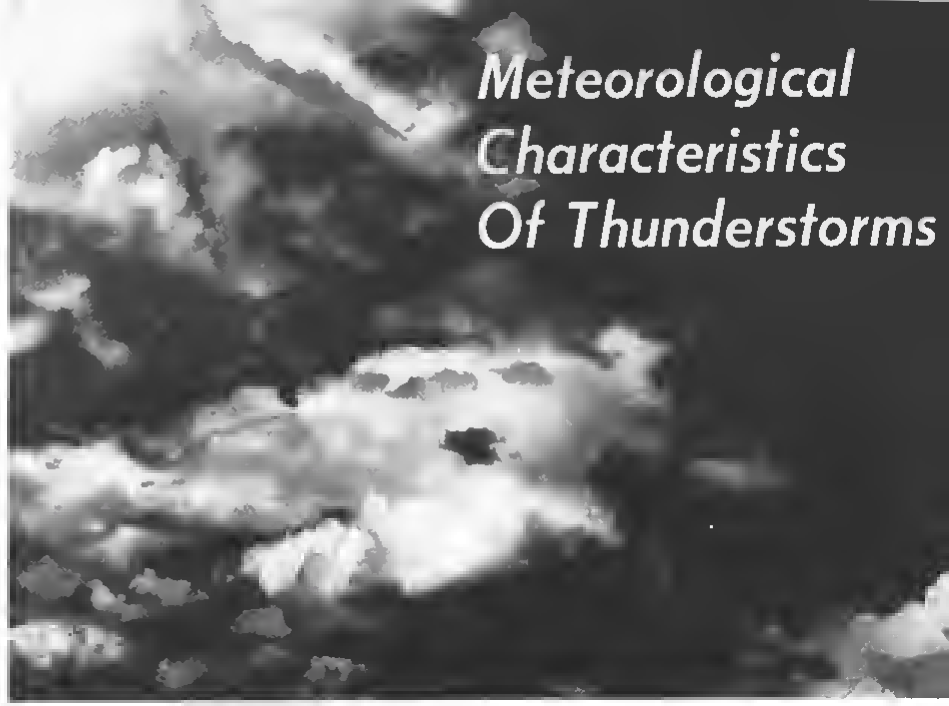
Delivery costs
Installation and servicing costs
Sundry specific contract costs

Administration and Distribution Expenses

General corporate and administration expenses
Building and selling and distribution expenses

The detailed descriptions accompanying the above mentioned items of cost pose no particular problems. It is noted, however, that "all conceivable items can not be mentioned specifically . . . and omission of mention is to be in no way restrictive upon the government in determining the costs of a contract." Further, "if an item of cost is not

(*Turn to page 30ff*)



Meteorological Characteristics Of Thunderstorms

For the first time, conclusive evaluation of the characteristics of thunderstorms is possible with availability of a suitable network of data and observation points. The results of these studies will be of considerable value to military, commercial and private operators. In the first part of this article the duration, movement relative to gradient winds, and circulation pattern of thunderstorms is discussed. Next month the energy characteristics will be analyzed covering the storm accumulative factors and energy expended.

By GEORGE N BRANCATO, *Associate Meteorologist*
Hydrometeorological Section U. S. Weather Bureau

THUNDERSTORM characteristics with respect to duration, movement relative to gradient winds, circulation pattern and amount of energy expended, have been difficult to evaluate because of the relatively small area covered by any single thunderstorm and the lack of a dense network of suitable rainfall stations. It is now possible to formulate certain conclusions concerning these characteristics as a result of a study utilizing the dense station network maintained by the Soil Conservation Service over the Muskingum River Watershed, Ohio.

Distance between stations varies from one or two miles to a little over ten miles. During parts of July and August 1937 and 1938 all of these stations obtained hourly observations of wind, weather, clouds, temperature and net bulk or additions to a continuous record of rainfall. These data were made available by Dr. C. W. Thornwaite, chief of the Climatic and Physiographic Division of the Soil Conservation Service.

Complicating the investigation was the fact that under favorable conditions, thunderstorms develop in groups or families thus increasing the area subject to rainfall. Three of these including the two with hourly wind observations, will be discussed in detail here.

Duration and Direction

Fig. 1 shows a series of thunderstorms which occurred over the southeastern portion of the basin on August 19, 1937. In order to place the series of half-hourly maps on one figure only the portion of the basin over which thunder-

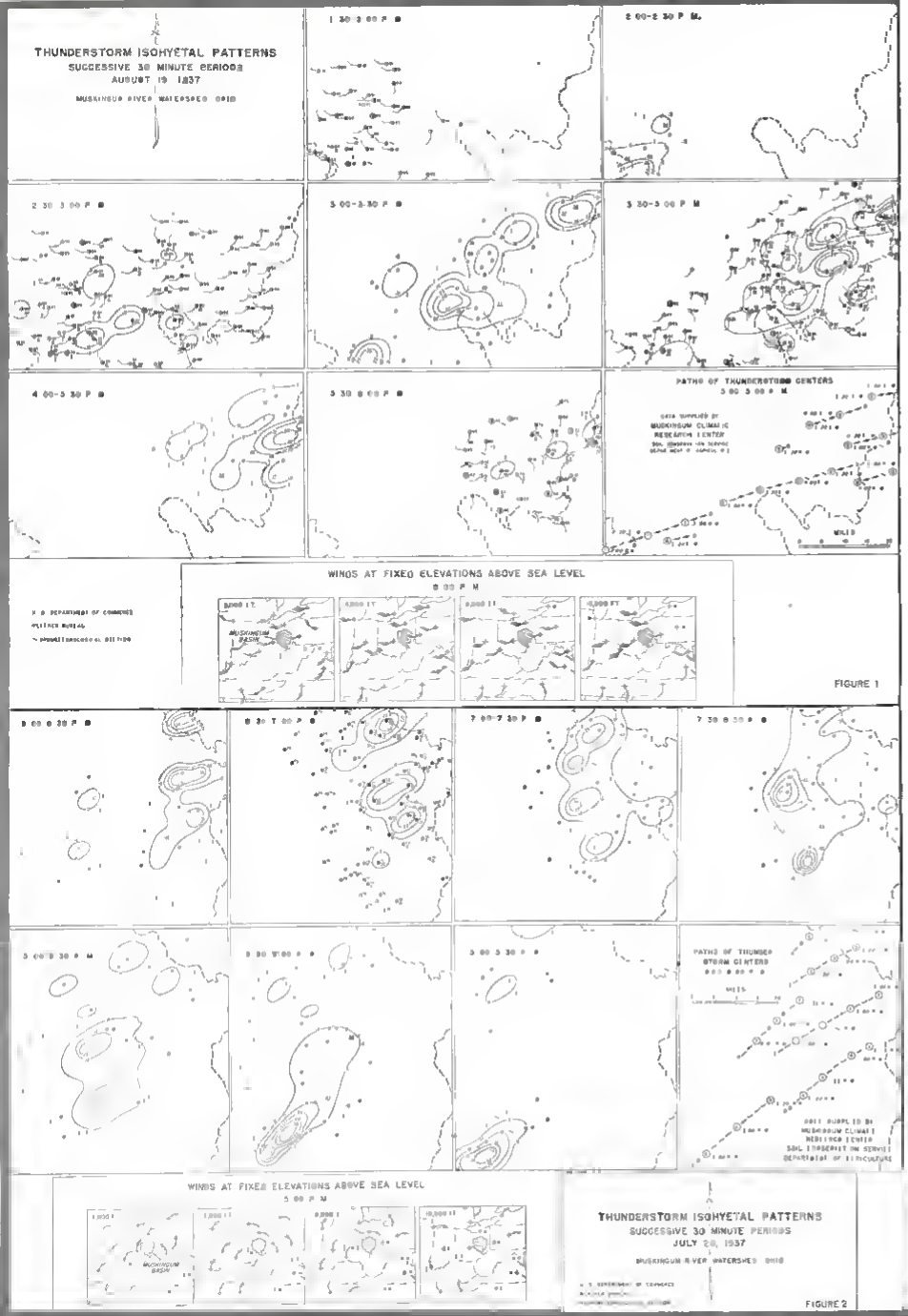


FIGURE 1

FIGURE 2

storms accurred has been reproduced Temperature, wind, and cloudiness observations were made hourly, but precipitation maps prepared from automatic records were made for half-hourly periods. Precipitation amounts are underlined at the right of each station to distinguished them from the temperatures Each thunderstorm has been numbered and the path as determined from the isohyetal patterns produced has been indicated In order to make a comparison of the movement of thunderstorms with the winds aloft, the 5 00 p m, E S T winds at 2,000, 4,000, 6,000 and 10,000 ft have been plotted for the northeastern portion of the United States.

The positions of the isohyetal centers on the successive maps show a regular progression of each center in an east northeast direction At 2.00 p m. there was one center which was just moving into the basin but by 3 30 p m. this center had dissipated and there were six other centers which had developed. The development of the additional centers is in advance of the established centers and suggests that their development is at least partially due to the advancing cool wedge of air preceding the thunderstorms The temperatures on each of the hourly charts are generally lower in the areas preceding the thunderstorms than on the sides and begins to fall five to ten miles in advance of the rain area

The average movement of the centers was about 20 mph from the west southwest, and the average wind velocity between 4,000 and 6,000 ft was also about 20 mph from the west southwest This indicates that the thunderstorms travel in the general direction and with the velocity of the wind at about 5,000 ft

Fig 2 for the thunderstorms of July 20, 1937, is of especial interest because of the northeast-to-southwest movement of the centers As in the August 19, 1937 case, the direction and speed of the thunderstorms as determined from the isohyetal patterns is definitely that of the winds at about the 6,000 ft. level Wind observations were not available and temperatures were available only for the 7 00 p m chart so that no comments relative to these elements can be made The charts, however, suggest certain interesting conclusions concerning the duration of thunderstorms. Thunderstorms Nos. 1, 4, 7 and 8 developed within the basin and each produced appreciable rainfall for not more than two hours Also, in each case, the maximum intensity was attained within one hour after the rain began Most of the non-frontal thunderstorms which occurred during July and August 1937 38 showed that they attained their maximum intensity within the same time

Storm Families

Fig 3, for July 8, 1938, shows the development of one thunderstorm within the basin at 5 00 p m and the subsequent development of three other thunderstorm centers. Thunderstorm No 1 attained its maximum intensity within one hour and then dissipated by 6 30 p m The additional thunderstorms developed in advance of the main thunderstorm center and, as in the other cases was apparently associated with the advancing cool wedge of air. The movement of the centers is in a northeast direction at about 18 mph., which is in agreement with the winds aloft between 4,000 and 6,000 ft

The Hydrometeorological Section has frequently noted that the total isohyetal pattern produced by a family of thunderstorms is usually oriented so that its major axis is nearly normal to the direction of the upper air winds It has been shown by Mr Solot of this section that the area of thunderstorm activity is coincident and moves with the area of convergence This convergence area usually moves from west to east approximately normal to the usual southwesterly current Thus, while the individual thunderstorm centers usually move in a northeast direction, the continuous development of thunderstorms moves to the right and produces a west

(*Turn to page 202*)

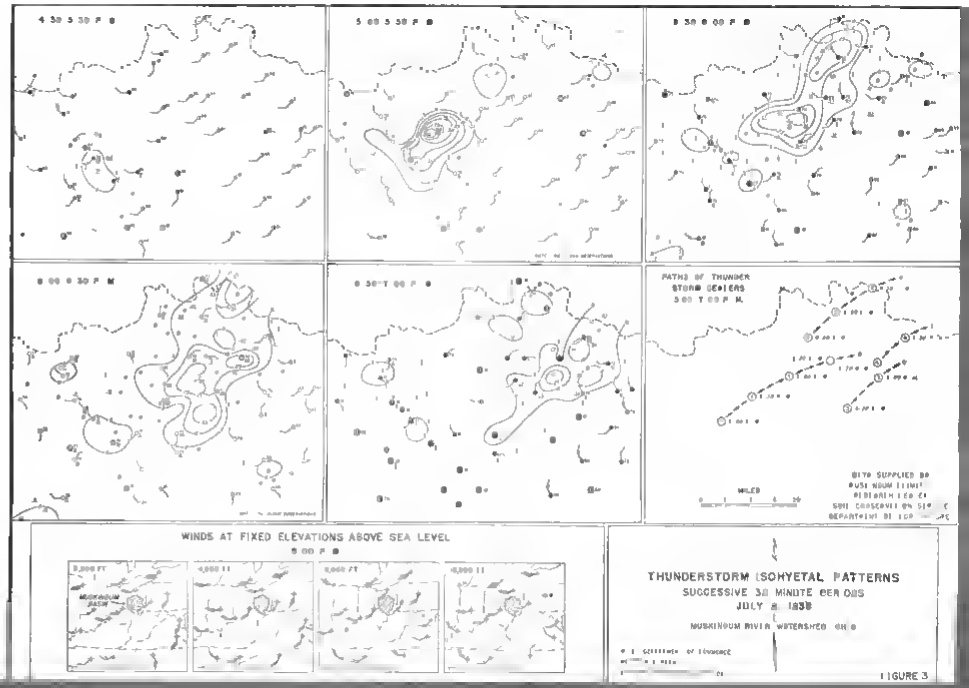


FIGURE 3







Modern warfare demands more than mere concealment of a given objective. Appearance of the entire location must often be changed to confuse enemy bombers. Successive steps as worked out with a model, are shown here. FIG. 1 shows a vertical view of a hypothetical manufacturing center before camouflage went to work. FIG. 2 shows the same plant after disruptive camouflage had been applied with sufficient alteration to confuse bombardier from 20,000 ft. or more. However, the bridge across the river and the two ship-loading slips would still give the location. FIG. 3 shows same location after total camouflage consisting of nets and fabrics, plywood shapes and camouflage paints. Note that one loading slip has completely disappeared, the tank farm has become a wooded area and the factory buildings themselves have become a residential area.

The How and Why of Camouflage

Expert explains new methods and materials in "architecture of concealment" made necessary by new offensive weapons.

By HARPER GOFF

TWO HOURS' FLIGHT from our West Coast, dawn is breaking over the ocean's rim. On the aircraft carrier that flies the flag of the Rising Sun, the flight commander is giving final instructions as the ship maneuvers into the wind:

"On the west side of Greenhill, look for two Greek theaters in the center of a large recreation park. Bomb anywhere in the recreation park, but particularly those Greek theaters. To your places!"

And that's how much good it would do to camouflage one target with another just as visible. Just one reconnaissance flight in search of the Greenhill Chemical Corporation—granted that the enemy knows its general location—would reveal the incongruous arrangement of Greek theaters and tennis courts that disguised respectively the huge vital storage tanks and the main sprawling manufacturing plant facilities, etc.

This is an exaggerated example, perhaps, but it is indicative of some of the rationale that must lie behind every single camouflage job which has been, or now is, quietly under way in America.

To call camouflage a science may be correct. But it is more than science—it is an art, with a definite technique. It may be properly called the "architecture of concealment." It is decidedly a tailor-made job—custom-built in the last detail.

During the months since Pearl Harbor, a handful of artists and engineers have been spending their days and most of their nights devising effective means of concealing West Coast defense plants from the eyes of the enemy.

As a member of this group, the writer has seen professional interest in camouflage grow from the single or scattered individual effort by a single designer here and there, to a group effort; thence to a series of organized camouflaging units. It was a rapid transition—but no more rapid than the gathering hunger for knowledge displayed by industry at large toward this architecture of concealment.

The information which these camouflage units have gained, substitutes neither professional nor government secrets, for their use belongs to every industry which in wartime, wants to protect its valuable assets and products for the nation's continued use through the "passive defense" of concealment.

There is no opportunity to employ mass production methods in the design of camouflage. It is not like a ready-cut home, a prefabricated fence that can be bought by the yard and installed according to a page of printed instructions and accomplish its mission equally well wherever or by whomever it is installed. It would be nice if the plant executive could phone his maintenance department and instruct it to order 20,000 sq. ft. of camouflage material and roll it over the factory like a carpet, thus removing his plant from the landscape as far as visibility is concerned.

On the contrary, local conditions of the terrain, such as proximity to the seashore, with its change in picture light, make it necessary for each job of camouflage to be given individual and specialized attention.

The camouflage designer is the man who formulates the scheme or manner in which each separate plant is to be observed. In my opinion, he should be on the spot and familiar with the operations of the factory under transformation. He must understand the manner of living of the people in adjacent territories. He must see with his own eyes traffic problems and points of concentration, and should observe

(*Turn to page 322*)









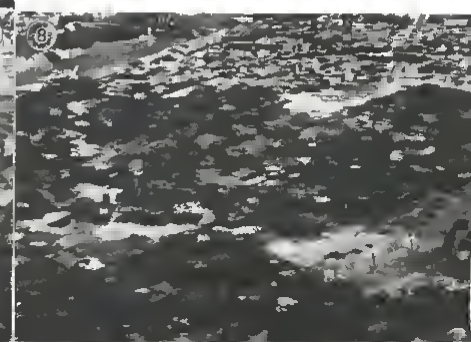
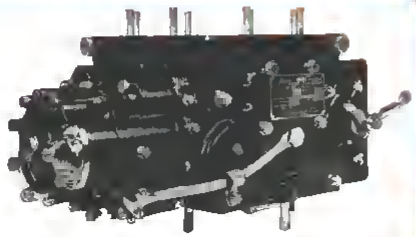


FIG. 4. Modern camouflaging involves alteration of surrounding reference points as well as the target itself. Width of river, type of bridge and other features identify the area. FIG. 5. The same scene after camouflaging. Screening of river house, wharves and bridge, narrowing the river through use of floating nets and disruptive painting are all used to confuse approaching bomber. FIG. 6. View from another direction showing storage tanks, four-track railroad line and other identifying features. FIG. 7. Here, disruptive painting with low visibility infra-red resistant camouflage paints alter the scene. A simple trainshed effect can be accomplished with painted chickenwire stretched over framework. FIG. 8. Total camouflage brought about by addition of nets, natural and artificial foliage and plywood shapes.

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In This Section

Prefabricating Aircraft Parts at Reynolds — W. G. Reynolds and David P. Reynolds — 108
Relieving Tooling Bottlenecks with Plastics — Leonard Weiss — 114
The Future of Water-Based Airplanes, V — Capt. Frank T. Courtney — 122
The Vidal Process for Molded Structures — E. Eugene Millar — 124
Testing Aircraft Cowl Fastaners — O. J. Poupitch — 128
Drop Hammer Technique and Innovations — Chris J. Frey and Stanley S. Kogut — 130
Harnessing the Stratosphere — Dwight Tenney — 137
Ice Indicator Devaloped — 138
New Valves Save Strategic Metal — 138
New Surface Milling Method — 143
Tool Life Sharply Increased — 147
Review of Patents — 148

AVIATION'S Sketch Book of Design Detail — 154
Hull construction of Vought-Sikorsky VS-44-A — 154
Wing cross section of Handley-Page "Halifax" — 154
Firewall details and fixtures, Vought-Sikorsky VS-44-A — 157
Armor and armament details of Heinkel He 111 — 157
Nose and cockpit construction in converted Aeronca TG-5 training glider — 158
Work platform in wing of Vought-Sikorsky VS-44-A — 158

AVIATION'S Engineering Data Book — 161
Time Control Chart—Aircraft Tubing — 163
Typical Stress-Strain Curves—Aircraft Tubing

New Products and Equipment for the Aviation Industry — 166
Information Tips on Timely Aviation Topics — 167
Modern Machine Tools — 172
Shop Equipment and Accessories

Subcontractors Section — 189
Subcontracting from Scratch — Eugene K. Gray — 194
Men and Machinery Available for War Work

PREFABRICATING AIRCRAFT PARTS AT REYNOLDS

By W. G. REYNOLDS,
General Manager, and
DAVID P. REYNOLDS,
Assistant Manager Aircraft Parts Division Reynolds Metals Company

The Reynolds Metals Company is prefabricating aircraft parts to manufacturers' specifications, releasing men, machines and plant space in aircraft plants for aircraft assembly, freeing millions of pounds of aluminum, ordinarily tied up as scrap, and greatly reducing transportation requirements.



Inspecting some of the parts produced at the Reynolds plants are (left to right) T. A. Lynch, general sales manager Reynolds Metals Company, Frahmen Anderson, president Anderson Aircraft Co., and David P. Reynolds, assistant manager, Aircraft Parts Division Reynolds Metals Company.

The War Production Board *has recently endorsed with enthusiasm the airplane parts prefabrication plan of the Reynolds Metals Company. High officials of the Aircraft Production Division of WPB are on record as concurring entirely with the effectiveness and efficiency of the plan, and the AAF Materiel Command is understood to have given the plan full recognition of its many advantages. The WPB has offered every possible assistance to the aircraft industry in securing the full benefits which the Reynolds plan offers.*

IN SPITE OF THE MAGNIFICENT accomplishment to date, more planes must be produced, faster—under infinitely more critical conditions of material, labor, machinery and plant, to say nothing of attendant critical factors such as transportation. In other words, while production to date has been accomplished despite some waste motion, the *running* combination will ultimately be productive ability plus maximum efficiency.

The Reynolds Metals Company is now implementing this combination through its Aircraft Parts Division. The Reynolds plan is simple. It involves the fabrication of airplane structural parts at the sheet supply source for shipment to aircraft plants where a greater proportion of effort can be devoted to aircraft assembly.

By fabricating certain structural parts at the sheet source, a substantial part of some 32,000,000 lb. of aluminum which is constantly tied up in the form of scrap can be released almost immediately for the production of hundreds of additional planes. Vital freight capacity utilized to carry scrap can be freed for other war purposes; duplication of critical machine tools can be cut down, a more efficient utilization of skilled labor can be accomplished; and critical floor space in aircraft plants can be released for additional aircraft assembly.

With complete shearing, routing, and blanking departments, thoroughly augmented by efficient facilities for die-making, template-making, drilling and inspection sections, the Reynolds plants are equipped to fabricate practically any flat part the aircraft manufacturers may specify. In addition, negotiations are now under way for the installation of Anderson "Forming by Drawing" machines (see AVIATION, June and July, 1942) to extend the productive versatility of the plants to a variety of formed parts.

Blanking and Shearing Plant

Within 24 hr. of receipt of blueprints for flat parts, blanking dies or router blocks and templates can be fabricated and set up, and production of the part begun.

There are two main fabrication plants for the production of aircraft parts. One is devoted to all blanking and shearing operations and is complete in itself from the die making department to inspection and shipping departments. The other plant is confined to production of routed parts and is also a complete unit from template-making to shipping.

Because present production is confined



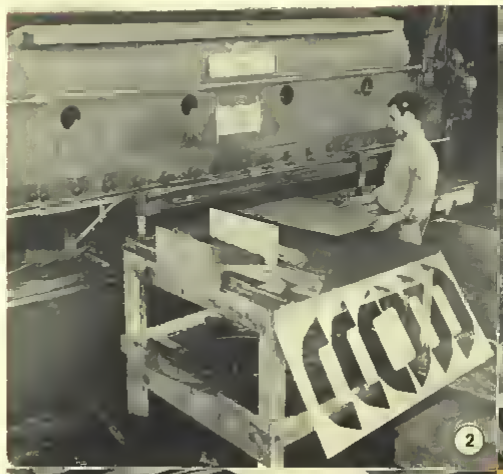






FIG. 1. Exhibit of smaller parts fabricated for aircraft manufacturers by the Aircraft Parts Division of Reynolds Metals Company.

FIG. 2. A Cincinnati press brake used for a variety of stamping operations. The machine accommodates a large die bed permitting the ready use of a wide variety of die shapes and sizes. Note the amount of scrap involved in the blanking of this part. Returning this scrap at the sheet source saves vital freight capacity and releases tied up metal.

FIG. 3. A battery of punch presses. Note the variety of shapes being produced and the large scrap bin which will take the scrap to the processing plants where it will be melted, cast and rolled into prime sheet within 24 hr.

FIG. 4. The die department in the blanking plant. Within 24 hr. after blueprints are received, dies can be made here and production begun.

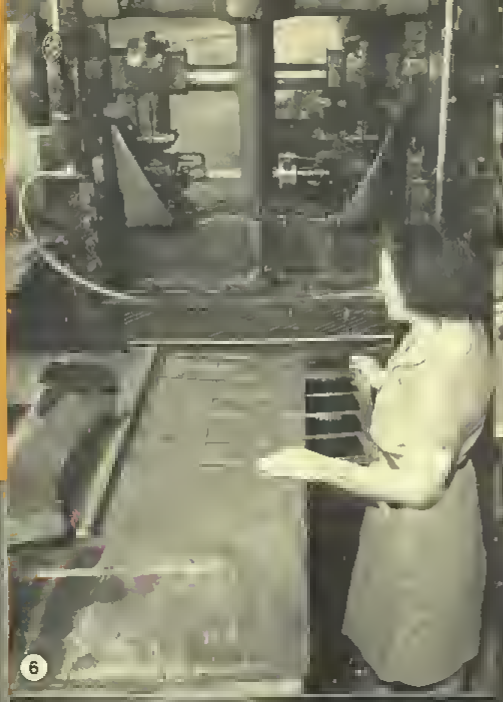
FIG 5 The die files where all dies are classified and maintained for repeated use on re-orders or staggered orders from different companies producing similar model airplanes

FIGS 6 7, 8 Other blanking machines used at the Reynolds plant FIG 6 Close up of a Niagara punch press in operation The blanking patterns are carefully planned to get the greatest possible use from each sheet FIG 7 A 350-ton E W Bliss mechanical press FIG 8 A small paper carton press used to blank small light-gage aluminum parts With action similar to that of a printing press the machine can blank a number of small parts at a time with considerable speed

FIG 9 The shearing department has twelve shearers with a productive capacity of nearly 2 000 000 lb of parts per month

FIG 10 The shipping room in the blanking and shearing plant is equipped with a roller conveyor system to facilitate handling All parts are checked by Army or Navy inspectors before packing











largely to flat parts, the shop set ups are relatively simple, permitting straight-line production on a highly efficient scale.

In the blanking and shearing plant, the die shop is uncomplicated but equipped to complete tooling for a large variety of orders in a minimum of time All dies are classified and filed in a large storage room where they are maintained and held ready for subsequent production runs. Where a number of different aircraft plants are engaged in the production of the same or similar model airplane, the staggering of orders may call for repeated use of the same die or one of similar shape The maintaining of these dies, therefore, frequently results in a substantial saving of cost, time and effort and permits production to begin immediately on a repeat order

There are at this moment 20 mechanical punch presses in the blanking shop, ranging from a battery of 30 ton presses to one of 1200 tons. Particular ingenuity of machine application is reflected in the use of a small cardboard carton press for high speed blanking of small parts of light gage aluminum In all, this shop has at present a capacity of well over a quarter million pounds of finished parts per month, and this capacity is increasing constantly

Under the same roof as the punch presses is the shearing department with twelve machines capable of handling nearly 2,000,000 lb of aluminum sheared panels and parts per month Because of the varieties of orders being worked on simultaneously in this department, careful planning makes it possible to get the most number of parts out of an aluminum sheet If, because of the shape of a particular part, only one panel can be cut from the original sheet, with a considerable amount of metal left for salvage, this salvage may be put to use immediately in the production of a different panel or part on the next machine While this is frequently done in any aircraft plant, the possibilities for immediate use of salvage metal are considerably increased here because of the diversity of orders and large selection of parts of different shapes

All finished parts go through a complete inspection procedure just as they do in an aircraft plant, and are given final approval by government service inspectors before shipment The shipping room is equipped with a roller conveyor system to facilitate the handling of crated parts

Routing Plant

There are nine routers in the routing plant with a capacity of turning out, on the average, 400,000 lb. of finished parts per month The largest routing unit is a double armed Onsrud machine mounted on a heavy central pedestal between two routing tables permitting routing operations to be performed on each simultaneously The heavy construction of the two router head arms eliminates chattering and enhances the steadiness and accuracy of movement All routing equipment is adaptable to cutting a number of parts at a time

Finished routed parts are drilled to specification. The drills for large pieces are mounted on ordinary routing machine arms, and here, too, the double armed type is used, permitting two men to work at different tables at the same time.

The routed and drilled parts are deburred and cleaned after which they go to the inspection department where they are thoroughly checked under government supervision and finally packed and shipped Packing is done with meticulous care, having in mind that success of the Reynolds prefabricated parts plan is due to a number of factors, one of which is the utilization of a minimum amount of freight space, and delivering parts in good condition ready for immediate assembly in the aircraft plant.

Running at capacity, the two plants are capable of handling and processing over 3,500,000 lb of sheet monthly

The Reynolds Plan

Since the war production program began in the United States a great deal has been heard of the term "subcontracting" Subcontracting is part and parcel of this country's industrial system and always has been where quantity production of intricate machinery has been involved Some aircraft companies now obtain as much as 85 percent of the dollar value of their product from outside sources. For the most part, they are concentrating on the job they know best —the design, engineering and assembly of finished airplanes The Reynolds plan

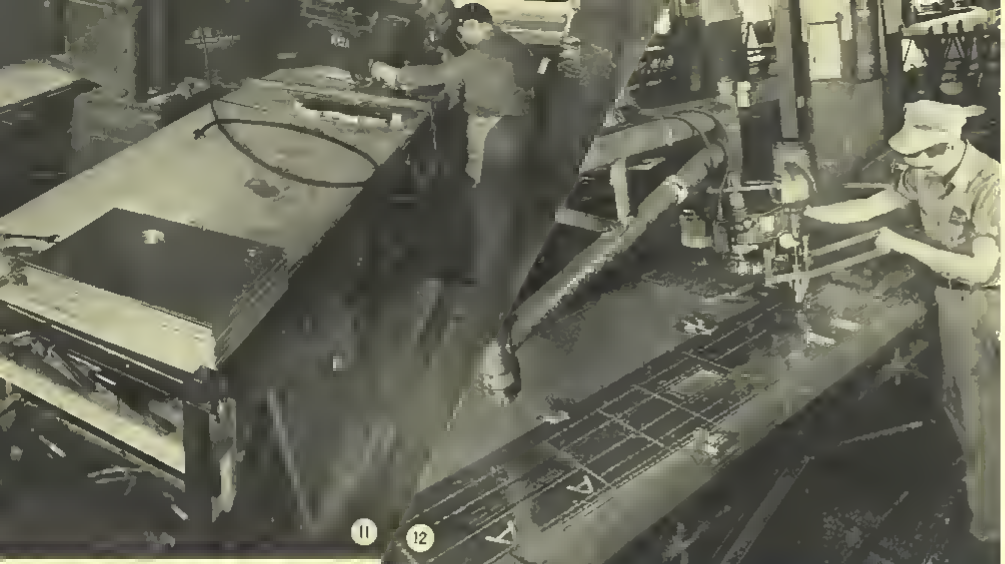


FIG. 11. An Onsrud dual-armed router is one of the many machines in the router plant. These heavy-duty routers have a wide range of applicability and are capable of a high rate of production.



FIG. 12. All parts are completed, ready for assembly. Here large routed panels are being drilled in accordance with manufacturer's specification.



FIG. 13. Completely machined parts are cleaned and deburred at these tables. Note the size of some of the parts produced by the Reynolds company for assembly in aircraft plants throughout the country.

FIG. 14. Each completed part undergoes thorough inspection and then final check by Army or Navy inspectors before shipping.



FIG. 15. Packing finished parts for shipment. Many parts are especially oil coated before packing. The ribs shown here are a fine example of some of the difficult routed shapes turned out at Reynolds. In the background are crated parts ready for shipment and containing 100 percent usable material with no return scrap.

is merely a logical and extremely practical extension of this production method to include certain airframe parts.

Included in this plan are all of the recognized advantages of subcontracting, such as the most efficient utilization and concentration of a skilled labor pool, elimination of duplicate machinery and tools—particularly in the cases where a number of plants are producing the same model airplane, reduction of slow semi-automatic operations of small lot parts, and release of floor space, manpower, and managerial effort in production plants to the tasks that can be performed *only* in those plants.

The Scrap Problem

Equal in importance to all of these advantages, however, is the retaining of scrap aluminum at the sheet source. An approximate average of 30 percent of sheet aluminum shipped to aircraft plants is returned to the aluminum mills as scrap. The scrap contained in prime aluminum sheet may be tied up for a period of time ranging from three to six months. This includes time in transit as sheet, in stock as sheet, in stock as scrap (awaiting sufficient accumulation for shipment), and time in transit as scrap.

Surveys have shown that the scrap loss of 30 percent is equivalent to approximately 9,000,000 lb per month. Thus, 36,000,000 lb. of aluminum is constantly idle, assuming 9,000,000 lb outgoing as potential scrap in sheet, 18,000,000 lb in stock in aircraft plants, and 9,000,000 lb in return transit as scrap. This is equivalent to the production capacity of a good-sized sheet rolling mill.

A very considerable organization exists in each airplane factory to specifically handle scrap. Millions of man hours are consumed in this work at great expense. The reason for this is that the value of scrap is so high (as potential prime sheet) that efforts must be made to conserve as much as possible. This results in additional production costs. One of the chief difficulties in scrap handling is that different aluminum alloys must be kept segregated for reprocessing, and the scrap must be kept clean and uncontaminated. The economy, and in many cases the feasibility, of reprocessing scrap depends upon its purity. Actually, a considerable amount of scrap is rendered completely worthless, as potential aircraft sheet, by contamination, mixing of different alloy scrap, and inclusion of ferrous metals of similar appearance in aluminum scrap piles.

There is more to the handling problem. In each aircraft plant, the tediously segregated scrap must be stored until there is a sufficient accumulation to warrant shipment. This space and inventory result in additional expense. Some attention must also be paid to the way in which the scrap is piled to secure maximum utilization of storage space and freight capacity.

That freight capacity is a critical factor is obvious. Thirty percent of the weight of the original sheet shipment is scrap. Ultimately this scrap must be hauled back, resulting in a considerable further utilization of vital freight capacity.

To take an example, 100 tons of aluminum sheet are shipped to an aircraft manufacturer. From this shipment 70 tons of aircraft parts will be fabricated and 30 tons of scrap will be returned to the aluminum plant. In all, a total shipment of 130 tons of metal is involved in the fabrication of 70 tons of parts—or nearly twice the amount of freight capacity utilized than would have been if the finished parts were shipped from the aluminum plant to the aircraft plant.

Mass Production Technique

As more and more plants are erected to build similar types of planes the multiple duplication of fabricating facilities approaches overall inefficiency. The tool making capacity of this country is already strained and anything alleviating this condition is of enormous assistance to the war effort. Assuming optimum conditions, the plan would eliminate the need for a large amount of tool duplication, and would, in effect, contribute materially toward increased production by permitting new plants to get under way on assembly work without having to wait for tooling.

In many cases where four or five plants are engaged in the production of a similar plane, the quantity of certain parts produced by any one of these companies is not great enough to warrant costly quantity production tooling. At the same time it is not practical for one plant to produce these parts for all the others because of their locations throughout the country. The result is that each plant fabricates these parts on a semi-automatic basis which means unnecessary handling, more man power, and frequently less accuracy and more waste. It is more in line with mass production technique for such parts to be fabricated on a quantity basis with accurate and efficient production tools at a single, central location (which in the overall picture is always the source of aluminum sheet).

In summary, the Airplane Parts Division of Reynolds Metals Company is equipped to produce practically any flat part required by the aircraft industry. In the near future the productive capabilities of the company may be extended to a variety of formed parts through use of the Anderson Forming by Drawing machines.

Use of this service will reduce the weight of aluminum shipped to aircraft manufacturers by approximately 30 percent and conserve vital freight capacity. It will eliminate unnecessary handling and release plant space for assembly operations.

Maintaining Scrap at the Sheet Source

Retaining scrap metal at the sheet source will permit the scrap to be remelted and re-rolled within 24 hr., automatically increasing the amount of aluminum available to the aircraft industry. Salvageable metal stocks will be increased by more efficient segregation of scrap alloys and freedom from contamination.

Duplication of machine tools will be reduced by the quantity production of parts for a number of manufacturers engaged in the assembly of airplanes of similar model. Skilled labor at the aircraft plants will be released for more necessary work—work which can be done *only* in aircraft plants.

This plan is in line with the increasingly necessary trend toward the most efficient utilization of the productive ability of the nation.

Relieving Tooling Bottlenecks With Plastics, I

Under the cast "Formrite" method of tooling, a plastic compound which hardens at room temperature in a few hours is utilized in making dies, jigs, and fixtures at less cost and in a fraction of the time required for similar metal tools. Subsequent articles dealing with other phases of the subject will appear in early issues.

By LEONARD WEISS
Brewster Aeronautical Corp.

ONE OF THE GREATEST single drawbacks to the quantity production of airplanes today is the bottleneck in production tools. The next, assuming materials of airplane construction are available, is the frequent change of design which causes wholesale scrapping of tools.

Pioneering of plastic tools and tool molds by Brewster Aeronautical Corporation is now paying dividends as the United States Navy *Buccaneer* and British *Bermuda* dive bombers roll off the production lines.

Known as the cast Formrite method of tooling, applications of this process were first considered by Brewster in the construction of the *Buffalo* fighter which won its wings for the British and Dutch as well as the United States Navy.

Now it has been more fully proved in building the *Buccaneer* and its *Bermuda* prototype, carrier based dive bombers with the U. S. and British Fleet Air Arms, respectively.

The cast Formrite method of tooling is a means by which advantage is taken of the casting properties of certain compounds in making tools and dies. In the production of airplanes, a regular sequence of procedure must be followed from blueprints to models, to tools, dies, fixtures, and through any other steps necessary to complete the program. As these steps are most important and difficult, the fastest, most inexpensive, and most accurate means of tooling is desired in order to fabricate the airplane parts.

There are many different methods of accurately transferring shapes, contours, lines, holes and other necessary developments from a part or blueprint to the tools involved in the manufacture of additional copies of that part.

The present methods of using layout men, templates, machining and hand work take too long and are expensive. The easiest, quickest, and most accurate way of arriving at these tooling shapes seems to be the cast method. A suitable compound is cast around an approved engineering developed model, or an actual part which has all the necessary shapes, contours, lines, holes and openings on its surface. This impression, suitably reinforced, forms the basis of the tool or fixture on which suitable production parts can be made.

Conserves Strategic Materials

The various government departments are interested in this type of development because it speeds production, releases skilled labor for essential jobs and conserves strategic materials, and is relatively inexpensive.

Interest has been shown in this type of development by the various aircraft manufacturers. Because of demonstrated advantages, it was decided at Brewster to concentrate on this particular cast compound method for further development. This development has been carried on for many months, but is by no means completed.

The tool bottleneck consists of the shortage of skilled labor, the time required for construction of tools, and the shortage of steel suitable for making tools. The following ideas on the construction of tools for the production of aircraft will probably be considered as unusual. However, from my own observations, I am convinced that the present methods of tooling for aircraft production are not fast enough for the efficient prosecution of the war. My method of approach to the tooling problem requires an entirely different outlook from that of many other tool men.

Several assumptions must be made:

1. That quantity production of fighting airplanes is required,
   (a) That at least one completed airplane of each required design is available,
2. That time is all important,
3. That costs should be kept down without sacrifice in delivery or quality,
4. That all available facilities for production must be utilized in the war effort,
5. That priority restrictions on material are there for a purpose and that restricted materials should *not be used* where available materials can be substituted,
6. That there is a shortage of skilled toolmakers and that any means of alleviating this condition is desired.

The situation as it exists today is as follows:

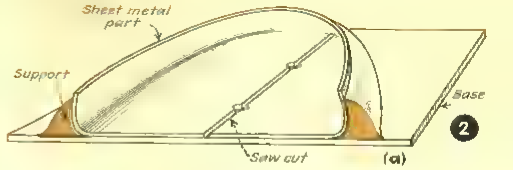
The government has decided to concurrently produce quantities of the best design of different types of airplanes in several scattered companies. This situ-



FIG 1. Several cast 'Formrite' stretch press forming dies used for cowling and fuselage panels. In certain cases both the left and right hand panels are stretched on the same die at the same time.



FIG. 4. A. Original sample part from which block was cast. B. Base section of split rubber form block. C. Tapered section of block. D. Formed aluminum alloy part pressed out on form block made from original part.



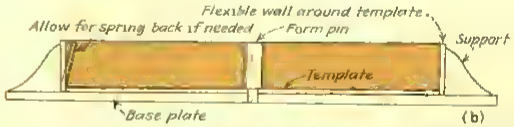


FIG 2. (a) Example showing use of an original part as a mold. (b) This part shows how a form block for a similar part could be made by using a template and supporting walls.

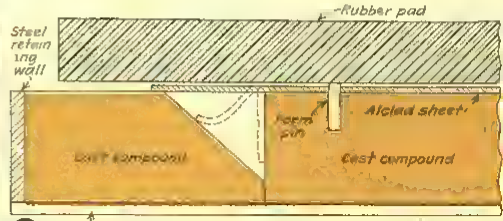


FIG. 3. This sketch suggests a method of making a form block with retainer to be used in a rubber pad press.

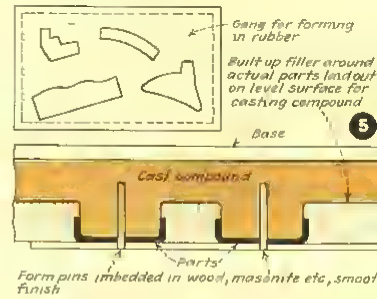
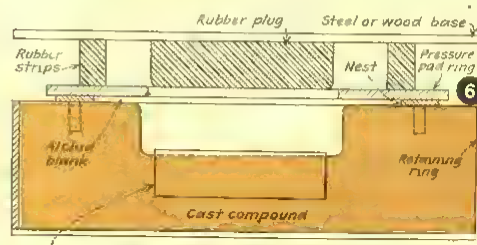


FIG. 5. In connection with gang forming with rubber (a) many adaptations of the cast compound method, such as shown in (b), can be used to good advantage.

FIG. 6. Rubber block can be used in a forming die to blank sheets by means of steel cutting edges inserted in the cast compound.



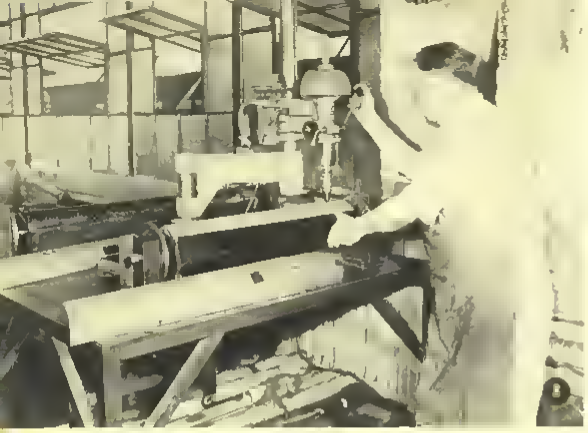
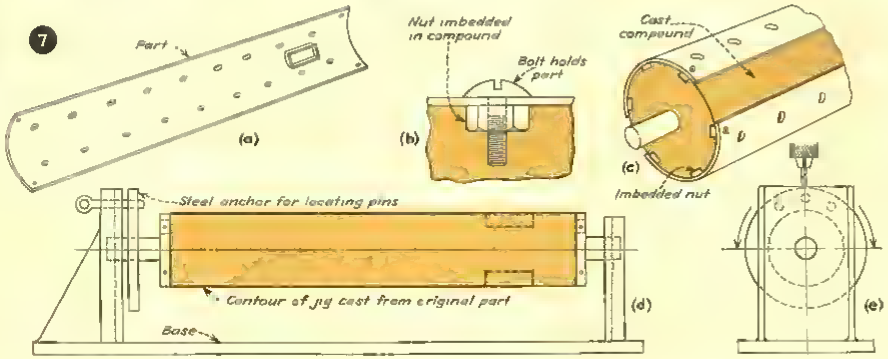


FIG. 8 Photograph of the countersinking fixture in use. Contour of the jig was cast from original piece. Index holes in part are located from the nuts imbedded in the plastic. Hull turn of jig makes opposite part ready for countersinking

FIG. 7 This ingenious countersinking fixture automatically lines up the part so that the drill is perpendicular to the surface. The part is held on the fixture by means of screws tightened into nuts imbedded in the compound



material, but we all know that such a condition is impossible. The next best thing to do is locate a material which approximates the characteristics of the theoretical cold cast steel. This is not easy. In the first place, metals must be cast hot and, because of this, have shrinkage upon solidification. This eliminates the possibility of using most metals.

With the assistance of Ralph Mancuso, of the Art Plastic Company, Woodside, L. I., we began research in plastic methods for tool purposes during 1941.

Many different types of plastic materials were surveyed during this investigation. The regular thermoplastics, phenolics and special cast compounds were tried. Mr. Mancuso is well qualified in the use of cast phenolics as he is generally given credit for being the inventor of the accelerator which hastened the setting of cast phenolics from seven days to a matter of hours. Also, the twelve largest phenolic castings—9 ft high and weighing approximately 1,500 lb apiece, denoting the twelve functions of the United States government—displayed at the World's Fair, 1939, were cast by him in rubber molds.

Having had this background and many other experiences with plastics which tended to prove that the then-existing plastics were not entirely satisfactory because of their inherent characteristics such as shrinkage, internal cracking, deterioration, heat limitation, length of time to cure, harmful effect of chemicals and the necessity for curing in ovens, Mr. Mancuso proceeded to develop a cast compound called "Formrite" to overcome these faults.

After a series of changes in the composition because of failures in service a suitable compound was decided upon. This compound can be varied from the resiliency of a rubber-like material to the solidity of a rock. It is important to realize that the correct variation of the compound must be applied to each particular job for the most satisfactory results. Some characteristics are gained at the expense of losing others.

The characteristics of the cast compound upon which we based our investigations into the practical applications were:

1. No shrinkage—tested up to lengths of 5 ft. for this characteristic,
2. Cast cold—no foundry or oven required; cures in 4 hr. at room temperature,
3. Hard smooth surface—reproduces fine detail; can withstand high compression loads,
4. Resistant to changes in dimensions because of atmospheric conditions; is water and oil resistant,
5. Withstands intermittent, slow heat to 1,000 deg. F.,
6. Material is not on priority and is readily available,
7. Material is inexpensive.

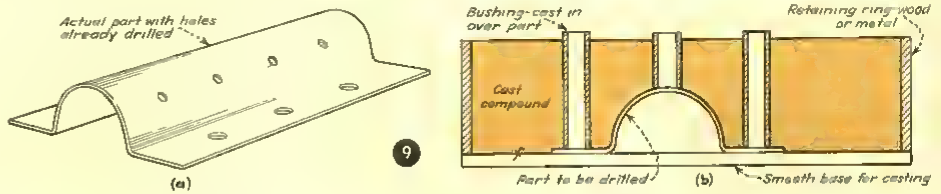
These characteristics were claimed by the manufacturer—the Art Plastic Company, Woodside, L. I.

The problem then was to utilize this material for practical uses in tools. Brewster cooperated closely with the Art Plastic Company in the development and application of this cast method of tooling.

The decisions in favor of the use of the cast compound were based on the following considerations:

1. *No Shrinkage*—The fact that the

FIG. 9 Another form of drill jig which can be made quickly and cheaply with the plastic compound



ation requires the manufacture of duplicate sets of tools for manufacturing an already existing proven plane. Automotive groups, in addition to aircraft groups, are tooling for production. The automotive groups are accustomed to large quantity production, consequently, they think in terms of steel dies suitable for turning out vast quantities.

Happy Medium in Tooling

The aircraft group, from the opposite extreme, has advanced from temporary tools to those designed for increased production. Somewhere between the two methods is the happy medium in tool construction. There is a great amount of skilled labor, equipment and time needed to produce the required steel tools. This condition exists because the tools have to be machined to shape. If this machining can be eliminated, a great step forward will have been made. If the steel could be replaced by some more available material, it would be still more advantageous. If the use of skilled labor and equipment could be eliminated, progress would be rapid.

The following is offered to provoke thought along certain lines. Even if 90 percent of the suggestions are rejected and only 10 percent are good, the method still will have contributed much. My contention is that the use of steel tools is unnecessary in certain forms of aircraft work, particularly in the shaping of aluminum alloy sheet. I believe that some of the present machine work is unnecessary and can be eliminated and that it is not necessary in certain cases to have skilled labor and expensive equipment in order to make satisfactory tools.

Steel has always been taken for granted as being the best material for tools. That may be so, but there are other materials which can be used for tools and yet produce satisfactory parts. It all depends upon the conditions under which the tool operates. Theoretically, if steel could be cast to the shape while cold and if it had no shrinkage and still retained its strength, our tool worries would be over. This would be a perfect

FIG. 10 A. Cast compound drill jig cast in retainer ring with clamp screw attached. B. Finished drilled part. C. Original steel type jig for drilling same piece. D. Cast compound drill jig cast in retainer. Part in place. Pins are inserted through holes in bushings and part showing perfect alignment of holes. Drill jig is shown in inverted position. E. Original steel drill jig for similar part. Two pieces drilled at one time. F. Cast compound contour checking fixture. G. Original steel checking template

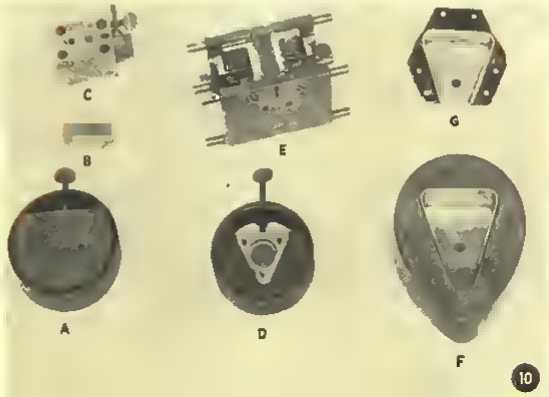
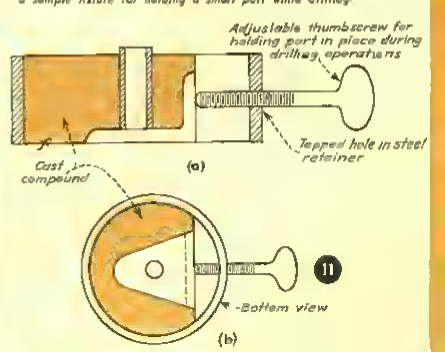


FIG. 11 A and B show sectional and bottom views respectively of a sample fixture for holding a small part while drilling



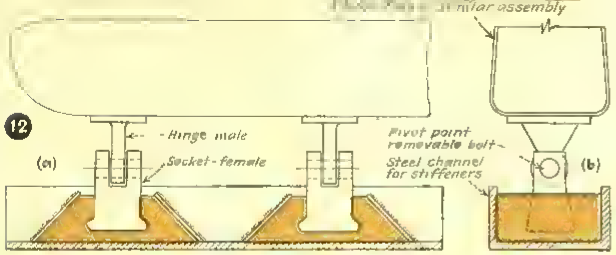


FIG 12 This dumonstrotes use of the cast compound for an assembly fixture to be used in alignment of hinge points Welded baffles hold cast compound in place to prevent shifting of fitting and to decrease weight

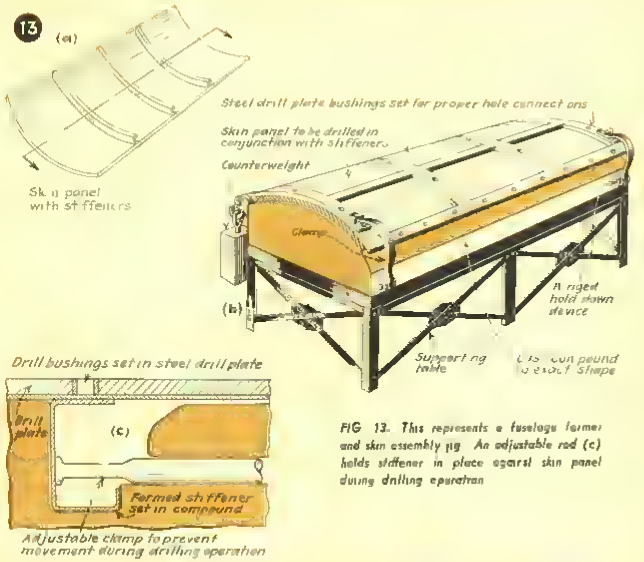
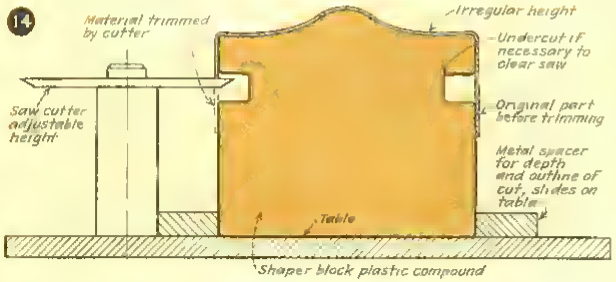


FIG 13. This represents a fuselage former and skin assembly jig An adjustable rod (c) holds stiffener in place against skin panel during drilling operation

FIG 14 A typical saw cutting fixture showing how shaper blocks can be made quickly and simply of the plastic compound



shrinkage can be controlled is a remarkable property. This allows an exact reproduction of the model and the consequent elimination of expensive machining operations The present plastic materials have various amounts of shrinkage, just enough to cause the use of oversize shrink patterns or to assure trouble in lining up accurate work In the case of jobs similar to drill jigs, accurate locations can be cast of this compound directly with no necessity for shrinkage allowance or back drilling to set bushings The compound cast on a stamped template created a reproduction with such detail that the raised and depressed letters fit perfectly If there were any shrinkage at all in the smallest letter, the metal template would not mate with the cast compound

2 *Cast Cold*—Formrite is cast cold, requires no foundry and cures in approximately 4 hr at room temperature The use of a thermoplastic requires heat The cast phenolics require special copper-coated kettles, because of the chemicals used The cast resin cures in an oven at 175 deg F. and consequently has shrinkage when it cools However, there are many special techniques developed by the Art Plastic Company in casting their compounds into tools for Brewster

3 *Hard Smooth Surface*—The surface finish of the part as it comes from the mold is exactly the same as the finish on the mold to the finest detail The compound may be varied so that it can dull an ordinary metal file In the case of forming dies the hardened surface is particularly useful In some variations the harder the surface, the more brittle the product One compound withstands high compression loads, while another compound is designed to take reasonable rough handling As a matter of note, Formrite can be satisfactorily metal-sprayed or electroplated where these applications are required

4 *Resistant to Changes in Dimension*—The compound stands up well in oil and water tests

5 *Heat Resistant*—Formrite, according to experimental tests, withstands slow heat up to 1,000 deg F In a series of tests, metal was cast 30 times at 480 deg F without damage to the mold Likewise phenolics were cast in a mold baked and separated cleanly without damage to the mold

6 *Priority*—Formrite is not on priority The other current plastics with which we have experimented, such as acetates, phenols and other resins, are in strict priority The same condition exists in the metal group Our experiments were made along this line specifically to find a non-priority material for tool making. The use of this compound may well release a quantity of badly needed materials

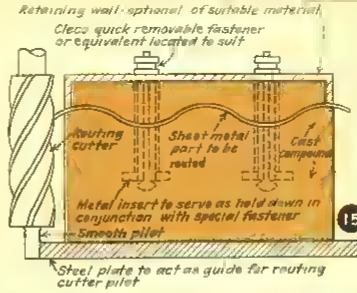


FIG 15 A routing fixture for a part of irregular shape with quick removable fasteners to hold the part in place

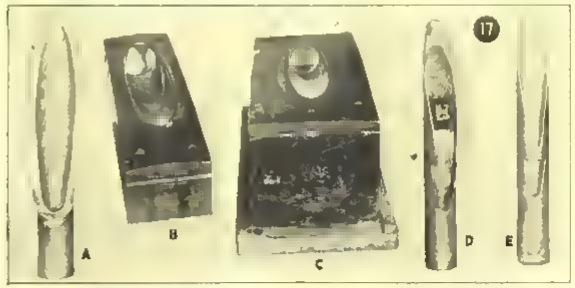
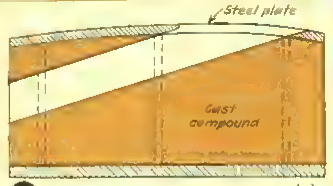


FIG 17 A. Finished stainless steel blast tube B Solid steel finishing block Note hogged out opening C Steel plate supported by cast compound First operation block. Note cast opening D Partially formed blast tube E. Rough cut stainless steel tubing



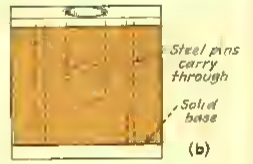


FIG 16 The compound is used here (a) to retain blast tube in specified position; (b) shows how the cast compound is reinforced by steel pins which transmit loads to a strong supporting surface

FIG 18 In male and female mating dies of the cast compound special design permits loads to be taken on steel guide pipes and pins which provide metal clearance thus eliminating the grinding action of die parts

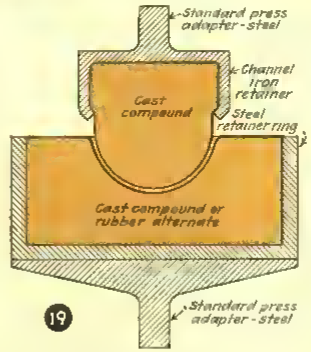
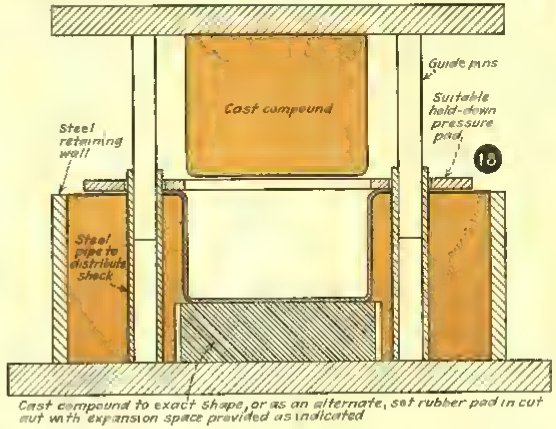


FIG 19 Here are suggested adapters for Vernon presses which are controllable to fractions of an inch and can thus prevent grinding of die parts



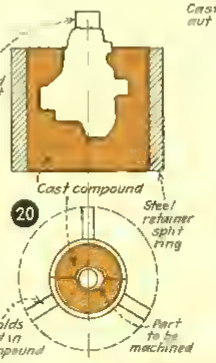


FIG 20 Lathe turning fixtures for irregularly shaped parts can be made readily by this method The part is imbedded in the compound inside a steel jacket which fits into the chuck.

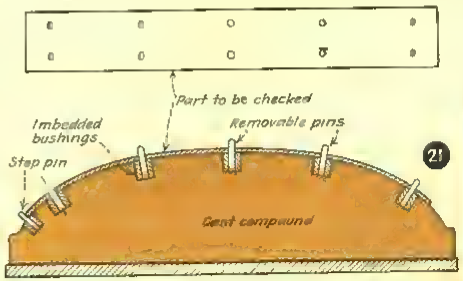


FIG 21 A fixture for checking hole alignments and contour

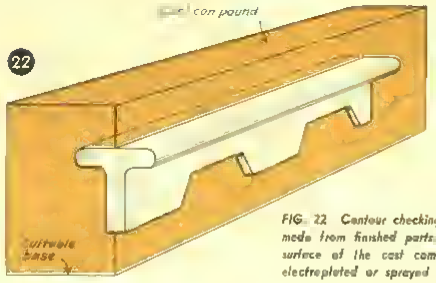
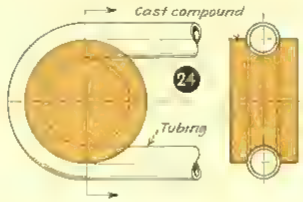


FIG. 22 Contour checking forms can be made from finished parts. If desired a surface of the cast compound can be electroplated or sprayed with metal

FIG. 24. In some cases a cast compound can be used for tube bending rollers.



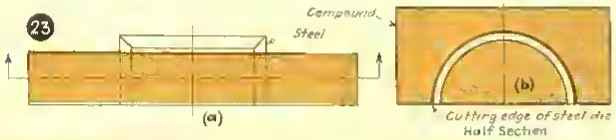


FIG 23 Sketches (a) and (b) show how the cast compound can be used as a support for suitable steel rule dies or imbedded cutting knives

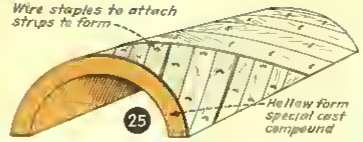


FIG 25 A hollow form of special cast compound can be used as a mandrel for forming plywood Wire staples can be used to attach strips to the form Heat and pressure can be applied and staples removed in the conventional manner



FIG 26 The cast compound can be used in some instances to make forming dies for transparent plastic sheets. Necessary contours are obtained from patterns and the heated thermoplastic sheets pressed between the dies

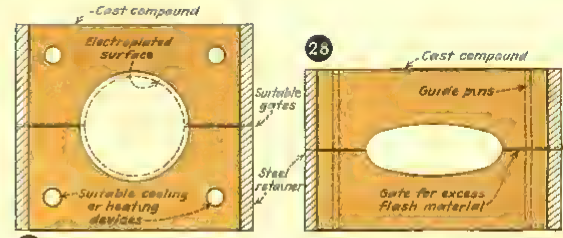


FIG 27 A typical injection mold for molding plastics and similar substances A special non-shrink compound is used so that expansion takes place equally and eliminates cracks and voids —— FIG 28. Another type of simple mold for cold molding plastics and other materials. Steel retainers absorb loads

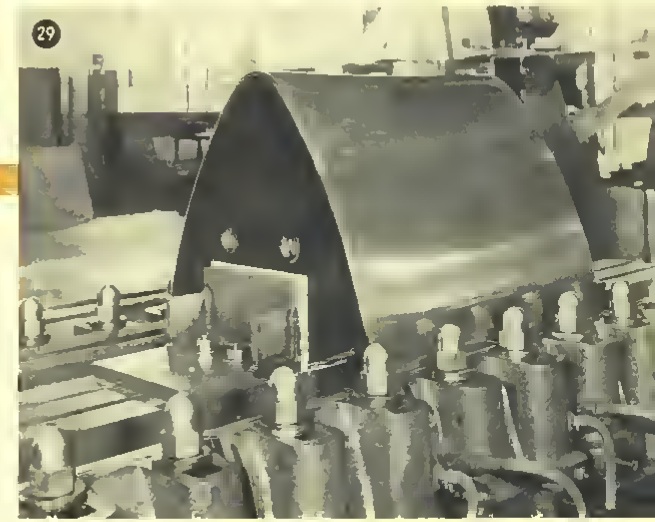


FIG 29 Section of cowling formed on Formrite stretch press dies at 100 tons indicated dial reading Double reverse curve and saddle back contour are formed over die Section is later cut along the center for left and right hand parts

7 *Inexpensive*—Cast Formrite tools have been made for Brewster by the Art Plastic Company, at a fraction of the cost of equivalent metal tools which perform the same job

Take the case of drill jigs There are hundreds of simple parts which require drill jigs For purposes of comparison, cast drill jigs have been made for $25 as compared to steel drill jigs for the same part at about $75 In many cases, the savings are even greater

8. *Time Saved*—The use of the cast method increases the delivery rate on certain tools from a matter of weeks to days and from days to hours These savings are the result of the elimination of hand fitting and machining in the manufacture of these tools In many cases tools can be made from actual parts, templates or models, eliminating time-consuming layout and inspection Whenever an original part is available and if the application is suitable, the cast method is a natural

9 *Skilled Labor and Machines*—can be diverted to more important work by relieving the work load of already overcrowded tool rooms by making as many parts as possible by the cast method Many tool designs are made of steel when another material would do the job These should be converted immediately, where applicable

It seems to me that entirely too much emphasis is being put on talking about the crying need for skilled toolmakers, and too little is actually being done about correcting the basic condition and using the available toolmakers to best advantage Too many people forget that a tool is merely a means to an end, and that a tool which can satisfactorily make the required quantity of parts is the only requisite The quicker temporary tools can be put in work, the faster we shall have planes

It should be cautioned at this point that this method is not offered as a "cure-all" for tooling problems It is in an early stage of development and much exploration remains to be done before its full possibilities and its limitations are known

However the cast method has one outstanding factor to offer—speed For example with the present type of steel drill jigs and fixtures, no matter how simple the part may be, the manufacture of that tool ties up a skilled man, a valuable milling machine or other equipment, or priority steel This time, machine and steel could well be used on the more difficult tooling jobs which cannot be replaced by the cast tooling method. The time has come to discard all prejudices that are in existence today, and to give a fair and honest try-out to this new method of tooling.

We have heard "can't," "won't" and "impossible" long enough These are urgent times, and urgent means must prevail

10 *Subcontractors*—A great portion of the work of prime contractors is subcontracted. Before delivery of the finished parts, the prime contractors must wait for the jigs to be manufactured by the vendor and must also pay the cost. In many cases the parts, when delivered, do not conform to the dimensions required by the prime contractor

By the use of the cast method, copies of the various tools required can be cast from an accepted part and delivered to the vendors and to the inspection departments, for their use In this way, interchangeability is assured and a source of delay and irritation removed Additional copies of the same tool can be made inexpensively and quickly because of the existing molds. This permits shipment of these tools to various plants having capacity Another important use is the potential value of having duplicate tools available just in case an aircraft tool room is destroyed by enemy action

In some cases, the tools may fail before the contract quantity of parts is completed When this happens, it is a relatively simple matter to make another tool.

11. *Limitations*—Of course, there are very definite limitations as to the use of the cast compound method. At present, it is not suitable for cutting edges, dies for sharp, sudden impact, such as punch presses, and long, slender parts subject to bending loads.

Considerable care must be taken in the design of these cast compound tools, as each one presents a separate problem

Many different wrinkles in casting these plastic tools have been worked out by Mr Maneuso and myself Special methods of mold construction, reinforcement and of mounting clamping devices and bases are required Certain precautions must be taken in the preparation of the molds and models Proper curing and controls are required

Use of Combination Material Tools

There are the "all or nothing" schools those who blindly champion all plastics all metal or all wood and so forth, without carefully deliberating the individual merits of each tool in relation to the whole program The ideal method of tooling should incorporate applications of each method of fabrication, depending on their ability to most efficiently fulfill the design function

Scope of Tests

Inasmuch as this was a new material and the reactions under load were not determined at that time, a series of tests were run on the tools and sample shapes made from this compound.

Some of these test parts are shown in the various illustrations

In the past, tools seemed to fail time and time again until the correct variation of the compound was applied We have gone through the period of internal cracking, hardness control and brittleness Certain definite variations of compound are now being recommended for specific type jobs. We expect minor difficulties and failures in the future For instance, we have had failures in stretch press dies because of the fact that the overhanging sections were not sufficiently supported and because of the fact that all reinforcements were eliminated for experimental purposes The actions of the material in forming compound curvatures in metal on the stretch press, under loads of 120 tons indicated dial readings, were noted

In rubber press work, some failures occurred because of the relative brittleness of one compound variation The sliding table of the press had certain uneven surfaces, which smoothed out under pressure but which caused the block to fail in bending A different compound was tried with more flexible characteristics, with successful results

One major difficulty with the manufacture of rubber form blocks has been the requirement that the same block must be used for bend rework on the bench Block after block failed in the vise The problem has not as yet been completely solved but the answer seems near

Miscellaneous general types of tests were made on items not necessarily specifically related to actual airplane part production These experiments will serve as a basis for later investigations into actual airplane requirements

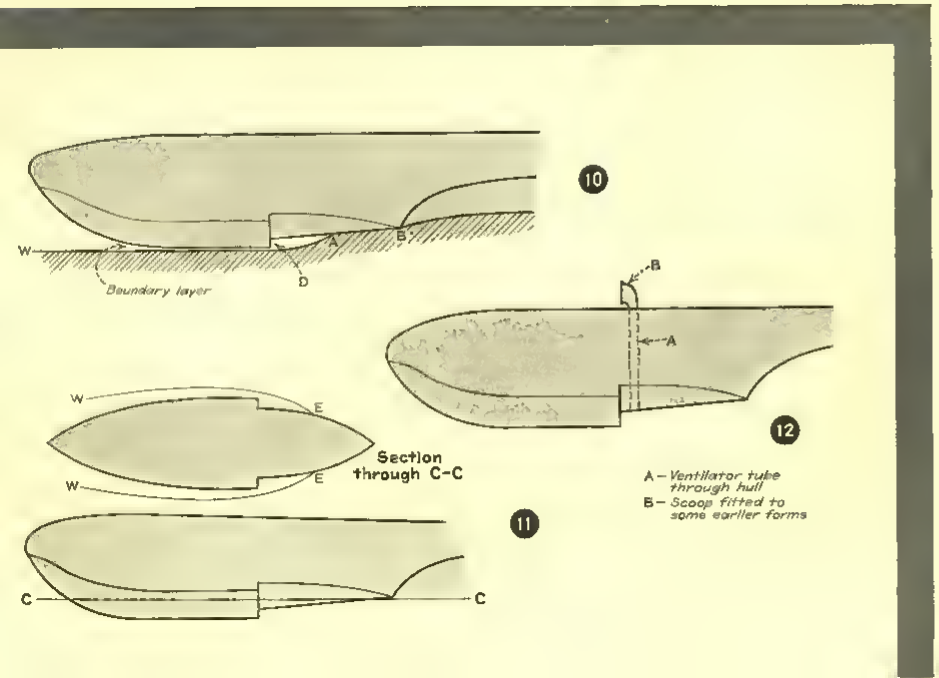
★ *ALREADY WIDESPREAD INTEREST has been aroused in Capt. Courtney's series of articles on design problems of water based airplanes. It is heartening that some of his views are receiving support from design engineers who are deep in present methods supporting the author's contention that design of waterplanes has lagged not because of any inherent inferiority but simply because far greater time and effort has been devoted to the design problems of landplanes.*

It is appropriate to mention here that Capt. Courtney, in addition to being a recognized authority on these matters in America and Europe, is a practical, piloting student of them and is even now actively flying water-based craft.

By CAPT. FRANK T. COURTNEY

THE FUTURE OF WATER-BASED AIRPLANES . . . V

This installment discusses the drawbacks of the steps and afterbodies of conventional hull designs, analyzes the phenomenon of "porpoising" and enters the little-explored field of hydrofoils.



THE MAIN STEP is as we saw on the evolution of the after end of the planing bottom of the early flat bottomed floats. The afterbody is the evolution of the original tail float and is there mainly to prevent capsizing backwards, it must therefore come into action when, at the start of the take off run, the main planing bottom takes on a high trim angle (Fig. 4). But in full hydroplaning the afterbody should be clear of water flow. So, as a compromise between these requirements, it has to be set at a moderate angle to the forebody, usually about 8 deg., and the step should be such as to keep water clear of the afterbody while planing. In theory, therefore, the afterbody is purely a rectifying body for abnormal trim of the main planing body, and the step is the aft limit of the latter. This principle has rarely, if ever, worked, and its failure becomes more and more obvious as loadings, drafts and speeds increase. Study and analysis show that this arrangement, persisted in for so long, can hardly be expected to provide anything but trouble.

Aerodynamically, of course it is a very prominent and notoriously well-known headwind.

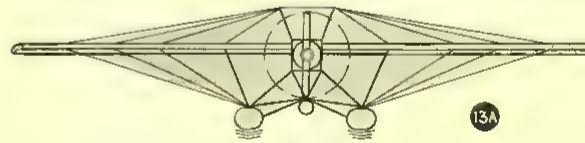
Hydrodynamically let us look at Fig. 10 in which line W illustrates the water flow from step to afterbody at some speed and angle around the hump. It strikes the afterbody at and behind point A. AB represents (all this is necessarily a very rough illustration) the water force on the afterbody. First, it can be seen that if step height and/or afterbody angle are increased, point A will move back until it is satisfactorily out of the way, this, however, if carried too far, will allow excessive tail down trim under static and low speed conditions, so it is necessary to keep somewhere within present average limits.

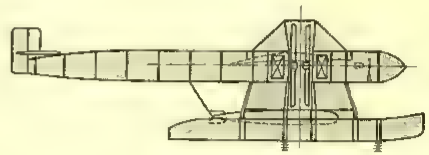
Secondly it can be seen that, if speed, trim angle and draft vary, point A may move back and forth accordingly: back if speed is increased and forward if draft is increased—and vice versa. Increase of angle may do almost anything because, with steady flow, it may move A back, or, with a stalled and burbling flow, it may move A forward. Length of forebody and boundary layer, with other factors, may also butt in, but we have enough variables to be getting along with. These may all be varying at the same time, with resultant variations in afterbody forces.

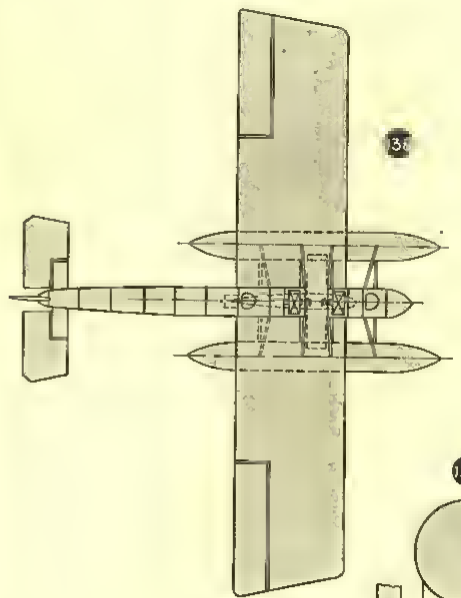
All this, however, omits the effect of deadrise. Figure 11 shows a horizontal section along line CC. We now have a sort of lateral step which was never in the program. Whether or how the forces from flow in this plane are mixed up with the wave-making forces I don't know, but suppose they strike the afterbody at E (which, remember, is still on the under side). Now E and A have nothing to do with each other beyond getting incalculably mixed up. A suction has been known to occur where pressure was expected.

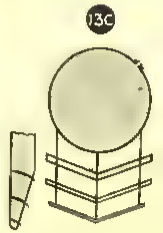
Finally we have the unknown forces connected with "suction at the step." At D (Fig. 10) there is formed under certain conditions an underwater cavity to which air has to get as best it can. Increase of draft (from either static or dynamic loads) tends to shut this cavity off still further from incoming air. Also the friction of passing water tends to drag away such air as is there and of course, that suction is greatest at high speed. When this occurs there is a negative pressure which sucks the hull down, if that force comes far enough aft the bow and CG will rise, air will be admitted, the bow will drop, and the whole process may be unstably repeated, (see "Porpoising" below). If it occurs at landing speeds, the air in the cavity may be sucked away so quickly as to drag the tail down and cause rebound. This effect has been fought ever since steps

(*Turn to page 314*)









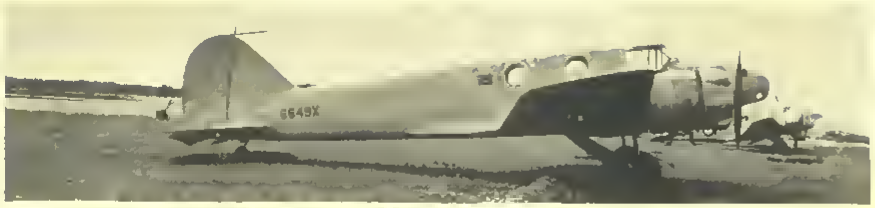


FIG. 1 (above) The fuselage for this Vidal "Anson" bomber is the largest molded plastic-bonded plywood structure in the world FIG. 2 (below) The "Summit" built by the Vidal process is the first all-molded plywood airplane Its sleek lines and clean surfaces provide for unusual aerodynamic efficiency and an unusually high rate of speed for its power



THE VIDAL PROCESS FOR MOLDED STRUCTURES

This is the first detailed technical description of the Vidal Process of molding wood and other materials for aircraft construction.

By E EUGENE MILLER,
Assistant Editor, Aviation

ONE OF THE MOST significant developments in the history of aviation is the molding of laminated wood structures into aerodynamic shapes with strength characteristics comparing favorably with metal construction A high point in this development is the Vidal process, invented by Eugene Vidal and Larry Marhoeffer and perfected by the Vidal Research Corp, holder of the patent rights

The Vidal process is the building up and integral molding of bonded laminated structures of wood or other materials by the simultaneous application of heat and pressure

The laminates are bonded together with a suitable adhesive, set by the application of heat, while shape is imparted to the structure by a mandrel under fluid pressure. As a matter of fundamental hydrostatic law, fluid pressure is exerted with equal intensity in all directions, but perpendicularly to surfaces in contact with the fluid. The Vidal process utilizes this law to apply suitable uniform pressure on the structure immersed in a fluid of steam, air, or hot water contained in an autoclave.

Prior to immersion, the structure is encased in a flexible membrane which is made to fit the structure snugly by exhaustion of air within the membrane enclosure The use of a membrane so described is but one of a number of methods used by the Vidal process for transmitting the fluid pressure A good bond and precise shape depend on the direct application of fluid pressure through the membrane to the structure The presence of air or liquid between the membrane and structure would result in energy loss at that point and unequal pressure application

Under the action of pressure and heat of the fluid, the adhesive coated veneers conform to the mandrel shape and the adhesive polymerizes, resulting in a molded laminated structure of permanent shape.

Mandrel Construction

The making of mandrels or forms is one of the most exacting phases of the process The Vidal company uses both male- and female type forms depending on the structure to be molded On the careful and accurate building of a mandrel depends the successful outcome of the molded structure.

The mandrel must be precisely accurate as to dimension, and must be constructed with due regard to the pressures and heat which will be imposed upon it. It may be made of wood, metal, laminated veneers, concrete, plaster of paris, or any other material In the Vidal plant, wooden mandrels are preferred principally because of ease and economy of construction and because in the veneer wrapping process to follow, staples can be used conveniently

It is necessary that the mandrel construction conform to a carefully balanced stress diagram to prevent collapse while under pressure When wood is used it is absolutely necessary that the grains be carefully balanced and that the surfaces of the mandrel be impervious to water absorption

The wood should be of uniform pattern and density, otherwise the surface will develop slight soft spots, or depressions Casein glue is used almost exclusively in form construction because it is boilproof and easier on the tools used in shaping the forms

Entirely [illegible] can be made over one master form by the Vidal process, thereby insuring duplication of all forms. In this type of construction the veneer should be impregnated with a phenol formaldehyde glue and then laid so that the wood grain is balanced Careful consideration should be given to the depth of all routing in order that the grain balance will remain undisturbed Laminated forms are hard surfaced, strong in construction, and easy to handle because of their lightness Stapling is somewhat difficult on these forms, but the method of construction has a great advantage where large production is a factor.

Veneer Templates

Good lofting procedure is essential to the successful application of the Vidal process to wood construction Proper strength characteristics depend upon the number of plys used in the various parts of the structure, the placement of veneers with respect to grain, and in reinforced structures, the size and location of the stiffening members which are formed and molded integrally with the sections during the forming operation.

In making templates for a new structure, the engineering department will specify the angle at which the grains of the veneer will run This is determined primarily by the stress requirements of the structure and secondarily by the ease of wrapping. Only so much can be done with a piece of veneer of specified width and thickness.

The initial step in making templates for any form is a cut and try process until the best and easiest set is determined The pieces are kept as wide as possible governed by the curves of the form and the thickness of the veneer specified. On mandrels of complex shape, it is good practice to begin templating at the most difficult spot Solving this problem usually results in fewer and larger templates The number of templates required is also reduced by shifting the templates so that the joints fit over breaks in the lines of the form or loose structural member inserts

Even though there is some latitude in the templating process, it is always essential that the individual pieces of veneer fit the form without buckling or overlapping (Fig 7) Careful and accurate templating makes for increased speed and precision in the wrapping of forms







FIG. 3. (right) Mandrel construction is a carefully engineered operation. Tolerances are held to close limits and strength characteristics are exactly predetermined A completed mandrel is shown on the table FIG. 4 (below right) Ribs and stiffening members are placed in slots of the mold before the skin is wrapped on. Reinforcing and shelf are formed and bonded in one operation. FIG 5 (below left) Applying the plastic resin adhesive to veneers with a roller type adhesive spreader







Before wrapping the skin veneers around the mandrel, the ribs or structural members are placed in appropriate slots in the mandrel (Fig 4) The exposed portion of these members which is flush with the surface of the mandrel are plasticized and in the forming process become an integral part of the structure

Wrapping the Mandrel

Wrapping of plastic veneers on the mold is a precise operation which must be performed with care Poor wrapping can upset all of the carefully worked out factors that go into the templating procedure and mandrel construction

The veneer is pressed tightly to the form, making certain that there is no tendency to buckle on the convex edges or to overlap in the concave areas (Fig 6) On most jobs the best practice is to start wrapping from the center of the form and to work in both directions, thereby speeding the operation and reducing the potential accumulating error With forms having unusual curves, wrapping is started with the most difficult pieces in the most difficult areas

It is general practice today to maintain the veneer in place by stapling (Figs 6 and 7) The staples are withdrawn as each layer of veneer is put on Wrapping is facilitated by having the limits of each piece clearly marked on the base of the form This is done by the templater and is helpful in the accurate fitting of the cut pieces Speed and precision in wrapping are obtained only by careful templating and accurate marking

Adhesives

Before cutting and wrapping, the veneer strips are coated with a synthetic resin adhesive agent (Fig 5) Because of the wide variety of types of thermosetting and thermoplastic resins and the continuous development by all manufacturers in this field, there is a wide range for experiment in this phase of the process The Vidal Research Corp is using both urea and phenol formaldehydes and is reluctant to recommend any one adhesive as superior to others Superiority of any adhesive must be based primarily on service requirements of the assembly and cost factors

Some forms of Plaskon, a urea formaldehyde, have proved satisfactory in a number of applications This adhesive will give an excellent bond and will flow into open holes and joints in the veneers. It does not penetrate very greatly into the fiber of the wood and rarely results in a starved joint It has excellent water resistant qualities

Durez and Amberlite PR14 are phenol formaldehydes which will give excellent bonds at low temperatures and are boilproof They show less tendency to flow before polymerizing than Plaskon, but their impregnating qualities are greater Impregnation of phenols can be diminished by the use of an agent such as wood flour or walnut flour in mixing the adhesive. The use of phenols is recommended where a certain degree of impregnation is desirable together with an excellent bond However, these adhesives are more sensitive to moisture content of the veneers and are more expensive to use It is necessary to clean the adhesive-applying machine with alcohol after spreading is completed

Of all phases of the Vidal process, that of plasticizing is the hardest for which to prescribe rules The types of adhesive to be used and the preparation of each type are determined by the difference in materials used in the construction and the desired results

The roller type of adhesive spreader with a grooved rubber roller has proved to be the most satisfactory for application of adhesives

Forming Membrane

Upon completion of the veneer wrapping operation, the form is ready to be placed into a pressure tank for processing Before it is put into the tank, however, it is encased in a fluid-proof membrane The purpose of this membrane is to act as a huge clamp on the assembly to be formed and also to transmit uniformly to the assembly the pressures applied within the tank

To date the most successful membranes have been made from Vidal fabric No 7664, made by the du Pont Company It is a non-elastic rubber-coated fabric that has been developed over the past four years As now made, there is approximately three times as much heat resistant rubber on the outside of the fabric as on the inside. The rubber on the inside protects the fiber from the ill effects of the adhesive and the oxidation that takes place at high temperatures. The outside rubber provides resistance to the pressure If the membranes made from this fabric are carefully treated, it is possible to complete over 100 forming operations with each. Pure rubber has been used, but the results obtained have been only about half as good as those obtained from the Vidal fabric

In order to maintain the maximum effect of pressure on the assemblies to be molded, the membranes are vented to the atmosphere Any leakage causes an increase of the pressures within the membrane above atmospheric pressure, thereby decreasing the pressure on the forms The vents should be as large as possible to more effectively remove excess gases and air admitted to the membrane through small leaks. It should be remembered also that rubber is not impervious to steam and air when under pressure and a certain amount of seepage through the membrane is unavoidable In general practice the mold is vented to atmosphere by means of a flexible metal hose.

Before placing the assembly in the tank, the membrane is sealed around the assembly in a completely vacuumized state (Fig 8) This is done with an ordinary vacuum pump and results in a very tight fit of the membrane around the form

Forming and Setting Operation

After the form is placed in the tank (Fig. 9) and the tank is sealed, the pressure is raised to about 50 psi by air Steam is then injected into the tank, raising the pressure to about 75 psi which is maintained throughout the forming process. The heat of the mixture of air and steam will range from 190 deg to 300 deg depending on the type of adhesive used This baking process may run anywhere from a few minutes to two hours in time

After the structure has been subjected to this treatment long enough for the adhesive to set or polymerize, the steam is exhausted from the tank and the air pressure released It thermo setting resins are used, the form can be removed from the tank immediately and allowed to cool at room temperature. If thermoplastic resins are used, the form is cooled within the tank with a cold spray of water and then removed The thickness of the veneer and structure as a whole, determines the length of the cooling period

The operation is now virtually complete and the assembly is firmly bonded and molded to shape The finishing operations consist of sanding, buffing and trimming where necessary (Figs 10 and 11). The unusual strength of reinforced sections formed by the Vidal process is the result of integrally forming and bonding the stiffening members within the section right from the beginning In the fuselage, for example, extraneous stiffening members are unnecessary except for the usual bulkheads (Fig 12)

Current Applications

The potentialities of the Vidal process seem to be unlimited. The first entire ship built by the Vidal process was known as the *Summit* (AVIATION, January 1941) which proved to be highly successful with unusual aerodynamic efficiency due to smoothness of construction (Fig 2) Plans for quantity production of this plane were interrupted by the war

(*Turn to page 299*)

FIG 6 (top) Wrapping the adhesive-treated veneer on a form The veneer strips are held in place by stapling, the staples being removed as each layer of veneer is built up. In a three-ply section the core layer is placed so that the grain is at right angles to the upper and lower plys Note the stiffening members already placed in the slots of the form FIG 7 (center) Wrapping a small form The veneer strips are cut from templates FIG 8 (left) Air is exhausted from the membrane in which the object to be molded is placed. The membrane acts as a clamp on the structure and transmits uniform fluid pressure built up within a tank by air and steam Figs 6 and 7, photos by Philadelphia Inquirer

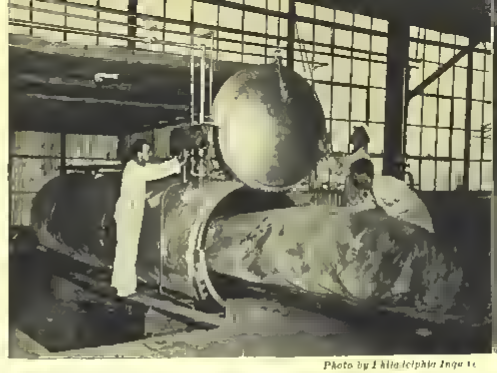




Photo by Philadelphia Inquirer

FIG 9 (above left) The membrane encased structure is rolled into a pressure tank where steam and air are admitted to exert the forming pressure and to provide the heat necessary to polymerize the resin adhesives FIG 10 (above right) After the forming operation the molded structure is cooled and cleaned off with a motor driven abrasive wheel FIG 11 (center right) Finishing is completed with a hand sanding and rubbing operation FIG 12 (below right) Looking aft in the Vidal "Anson" bomber fuselage The structural members are molded and bonded integrally with the shell resulting in a strong monocoque construction



Testing Aircraft Cowl Fasteners

Testing serves a dual purpose. It determines the ability of the product to perform its design function, and aids in the ultimate development from the original design stage.

By O. J. POUPITCH
Director of Research, Shakeproof Inc.

A VITAL COMPONENT PART of an airplane such as a cowling fastener needs something more than just good design to make it a successful product. It needs research, and the basis of research procedure is adequate testing procedure which will prove the applicability of the product to its design function.

In between initial design and final development lies a long series of grueling laboratory tests. Taking our own cowl fastener for example, the original fundamental design idea, a spring member operating on the principal of the cam, remained basically unchanged throughout the entire series of tests. These tests included initial tension, ultimate tension, shear, endurance and fatigue, vibration, locking and unlocking torque, curved sheet application, and behavior under temperature conditions—all to be met satisfactorily under the new proposed Army Navy Specifications. Even though the basic design idea remained unchanged, many modifications and refinements were made in the light of data secured from tests performed in accordance with proposed AN specifications.

The exacting test requirements under AN specifications include the following:

Initial tension
Ultimate tension
Shear
Endurance or fatigue
Vibration
Locking and unlocking torque
Curved sheet application





FIG. 1 (above) Fatigue endurance test. Ten specimens mounted five on each side of the automatic device to duplicate normal locking and unlocking operation. The number of cycles are recorded by the counter at the right. FIG. 2 (below) Tensile test of cowl fastener assembled in actual use. The axial pull is applied in the tensile testing machine through suitable fixtures.

Tension and Torque

In the study of axial tension (Fig. 2), two types of tests were conducted, one of axial tension within the elastic limit and one beyond the elastic limit. This essentially consisted of mounting the cowl fastener assembly as it would be normally used, and creating a forced separation between the structural parts up to the ultimate.

Initial tests disclosed early weaknesses in design, material and heat treatment. Through a series of modifications, the various failures were eliminated, and the strength factor of the fastener increased to its maximum.

The function of the spring member within its elastic limit was studied both from the standpoint of tensile strength and torque. The curve (Fig. 3), was secured by plotting the deflection per unit load in increasing increments up to a predetermined limit, and then decreasing the load to zero. This graph disclosed the "set" of the fastener, taking into account some instrumental error of the testing fixtures. On the basis of a series of such tests, and subsequent modifications, the part was refined to eliminate most of the set.

The torque tension relation (Fig. 4), is essentially a characteristic of operation and safety. Here, the object was to have the torque increase with increasing tension. This adds to the safety factor of the fastener against excessive stresses often caused by abrupt changes in direction of flight.

As a further precaution against such adverse stresses, the flexing action of the resilient upper bridge of the main spring was limited to within a specific range of deflection, beyond which it is blocked by a reinforcing strut. Any

(Turn to page 332)

HOME

When a Navy pilot flies away on action, he's alone with his powerful engine in a world of sky and sea ☆ His radio is silent. If it gave him guidance it would also guide the enemy. What confidence he must therefore place in his instruments! ☆ They must help him find pin-point like objectives in the ocean and then show him the way to go home ☆ They must also report to him the performance of his engine every mile of the way ☆ They must be instruments of the highest precision and accuracy. Instruments such as Kollsman makes for both Army and Navy aircraft of the United States and Allied forces!

Photograph Courtesy of U.S. Navy

KOLLSMAN
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FIG. 1 Drop hammer department in a Ryan Aeronautical Company plant

DROP HAMMER TECHNIQUE AND INNOVATIONS

The already apparent versatility of drop hammers for metal forming can be augmented considerably by relatively simple methods. Close control can be maintained through use of progressive dies and rubber pads to localize pressures and prevent wrinkles

By CHRIS J. FREY, *Brewster Aeronautical Company*
And STANLEY S. KOGUT, *Eastern Aircraft Production Forum*

THE USE OF A drop hammer in aircraft is a technique considerably different from its use in other fields Aircraft skin requires exceedingly high tensile strength and corresponding lightness. Strength-weight ratio is very high This brings with it certain inherent obstacles Spring back becomes an important problem In view of the strain on aircraft surface is under, there is little choice but to use this type of material When using a soft metal, spring back is nonexistent but with the harder stocks spring back becomes increasingly important in proportion to the hardness increase and it must be compensated for in the tools. In most other fields a metal can be chosen with regard for its simplicity of manufacture Where an operation is less complex with an easy flow deep drawing metal, it is used in preference to one without those qualities No choice exists in aircraft.

Hammer Fundamentals

With simple pieces, the first operation consists of lightly pressing the sheet down into the die. A light blow of the hammer is sufficient. The punch is then raised and the condition of the metal inspected. Just where wrinkles are starting to form can be quickly discerned and compressed If any wrinkles have started, they must be hand hammered or they will fold over and produce a lap in the metal Blows of the punch will not serve to remove wrinkles once they have started The first blows of the hammer should be light ones. They should be gradually increased in intensity so that the final blows are the heaviest Wrinkles may occur at any stage of the operation but they are not as apt to occur as in the beginning. Regardless of when they occur, the same procedure of hand hammering them out must be followed Certain types of work require no shrinkage These are very easy to do No precautions are necessary A few good solid blows of the hammer complete the part.

The face of the die should be frequently wiped with oil to facilitate forming Where we have a deep draw, there is a tendency to wrinkle. Other factors being equal, this tendency to wrinkle is exactly proportionate to the depth of the draw and the ability of the operator to control them. Wrinkles will tend to develop particularly in the area where shrinking begins As long as the metal can be encouraged to shrink and increase its gage, wrinkles can be avoided When a point is reached where further shrinking is no longer possible by any method, the maximum depth of draw has been obtained

There are, generally speaking, three different methods for forming parts that might wrinkle if they were shaped without any precautions—

1 Where the sequence of the blows is controlled by the removal of layers of plywood and rubber placed between punch and die,

2 Where the sequence of the directions is controlled by a series of progressive dies,

3 Where the blows of the hammer cause a flow of rubber to shape the part

Pressure Rings

Wrinkles are controlled by layers of plywood, rubber, or a combination of both These layers vary from 3/16 to ½ in in thickness and are commonly known as "pressure rings." They are piled up on the sheet metal after it is placed in its position on the die ... to a height of slightly less than the contemplated draw If the draw is to be 7 in, then 6 in of pressure rings are laid upon it In this way, only a 1-in draw is put into the metal on the first blow because of the restraining action of the rubber or the plywood.

In addition to the plywood and rubber rings, the usual practice is to place a steel ring of the same shape as the other pressure rings on the bottom directly over the metal sheet (Fig 5) The plywood and rubber pressure rings are then piled on top of this steel face It is obvious that in production a soft face of rubber or plywood would not entirely prevent the sheet from wrinkling inasmuch as the pressure of the metal against this face would force it upward If the rubber were in contact with the sheet, it would not prevent the metal from wrinkling and would itself flow into the wrinkle lines If the plywood were directly over the sheet, the metal would ultimately gouge it out. Consequently the steel ring which is considerably stronger than the other materials serves as a wrinkle preventative, and also acts as a wear strip preserving the life of the plywood and rubber

Another advantage in having a steel pressure ring in contact with the metal sheet from which the part is being formed is that it does not retard the flow of the metal into the die as much as rubber or plywood The softer face of plywood or rubber would have a tendency to keep the metal from slipping as it should

The deepest draw that can be made in each instance can be determined by experimentation A few blows of the hammer soon reveal the greatest depth possible without tearing After each blow, at least one, and preferably as many pressure rings as possible, should be removed. The more rings that can be removed after each blow of the hammer, the smaller the total number of strokes that will be necessary to form the parts The depth of the draw resulting from a particular stroke will bear directly on

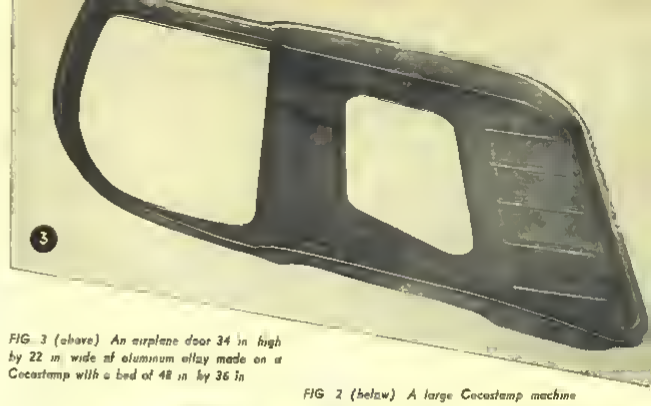


FIG. 3 (above) An airplane door 34 in high by 22 in wide of aluminum alloy made on a Cecostamp with a bed of 48 in by 36 in

FIG. 2 (below) A large Cecostamp machine at work on outboard skin panels for a pursuit plane Material is 040 Alclad



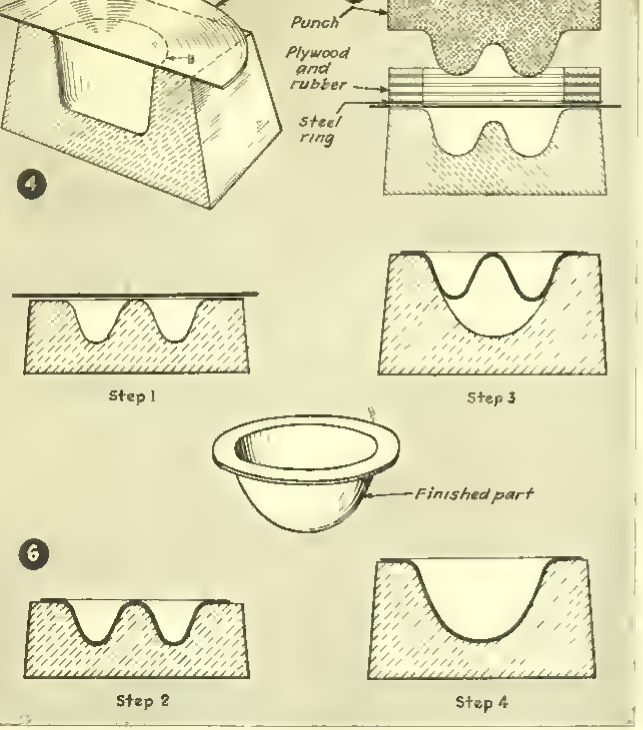


FIG. 4. In drop hammer work since material must be shrunk from the edge length of A to that of B, wrinkles will occur in this area if proper precautions are not taken. FIG 5. Steel plate, plywood, and rubber used as pressure pads to prevent wrinkles from starting in a deep draw. One or more sets of pressure rings are removed after each blow providing control over the depth of draw and formation of wrinkles throughout the operation. FIG 6. Two-operation progressive dies for forming a part such as a nose spinner.

the total thickness of the pressure rings.

Successive Dies

The purpose of successive dies is the same as the use of pressure rings, i.e. the elimination of wrinkles. By successive dies we mean a series of one or more dies, each one bringing the projected part closer to its desired shape. The depth of the draw from each hammer blow is accurately controlled and the possibility of tearing is practically eliminated. The first step is usually a roughing operation, the idea being to draw the metal into deep pockets or corners and over generous radii, and the second is used to finish the part to correct dimensions. While two, and sometimes three, operations are the general rule in this type of work, additional operations may be added if they are necessary.

Some manufacturers shy away from this method of production because of its apparent exhorbitant cost and prefer pressure rings. Actually successive dies are inexpensive because only the last die need be accurate and the only one into which any kind of workmanship is put.

All intermediate dies can be made with little regard for tolerances as long as they bring the shape of the part closer to its final shape (Fig. 7). The last of a series of progressive dies will usually remain in service longer than anticipated because the brunt of the work is borne by those earlier in the progression. Progressive dies can very often be used to make parts that would be very difficult to make, or perhaps impossible to make, with stripper rings. Progressive dies can be cast together so that more than one die can be used on a hammer at the same time. Depending on the size of the part, and its relation to the size of the anvil, two or three successive dies can be cast together (and their punches also). With each drop of the hammer, each part is moved one step further along the series. This method has the advantage of not being up any more equipment than is necessary.

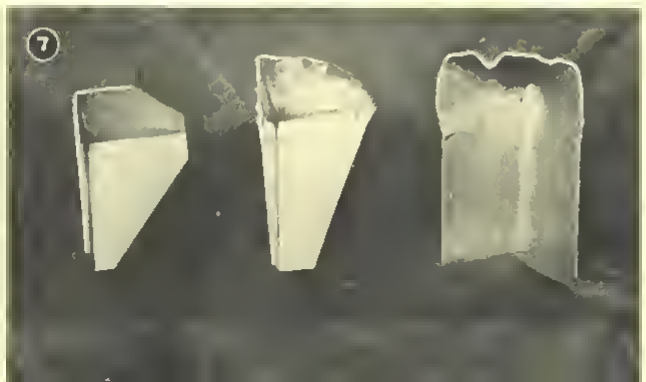


FIG. 7. Example of use of progressive dies to form a corner angle. Three dies are used each of which brings the sheet one step closer to the final shape. Close tolerances are necessary only on the final die. The initial and intermediate dies need be only rough approximations as to dimensions but should be designed to cause the easiest flow toward the final shape.

Fluid Pressure

Very often, the ability of rubber to flow in the manner of a fluid when under pressure is utilized to make parts with a drop hammer. The blow of the punch against the rubber will force the rubber up against the sheet in a place that might otherwise be inaccessible. Pneumatic hammers are preferable for this type of work.

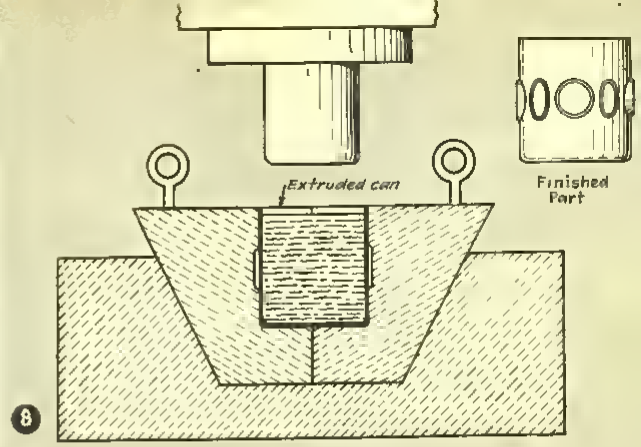
The force of the punch up against the rubber is used to form bosses on an extruded round can utilized for a junction box (Fig. 8). Rubber can be used to a great advantage in many cases. Because of their compound shapes, certain bends of a part may have to be formed first in order to prevent tearing or at any rate, excessive stretching. A piece of rubber placed on the sheet above the spot on the die where trouble is expected will localize the blow (Fig. 9). What actually happens is that the sheet below the rubber is formed before the rest of the sheet. The rubber is then removed and the part finished in the regular manner.

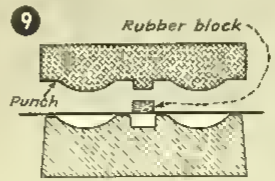
Notched Dies

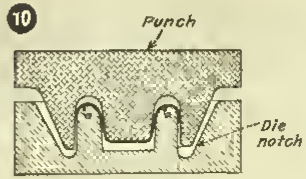
As a means of avoiding wrinkles in a deep draw, grooves are sometimes cut into the die and mated by the punch (Fig. 10). As the hammer falls and starts to draw the part, the groove acts to restrain the sheet in the manner of pressure rings. The construction of the die is not always one that will permit the cutting of a groove around the shape of the projected part. Very often pieces

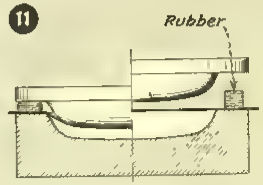
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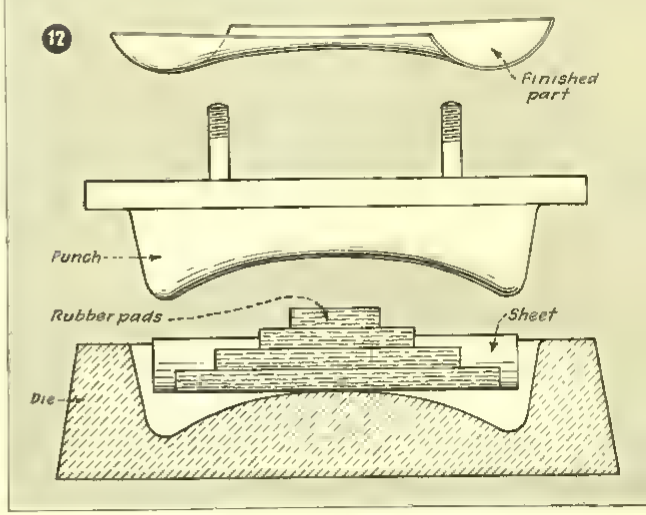
FIG. 8. To form bosses on an extruded round can, the can is filled with rubber (oil might be used) to apply pressure to the vertical sides for forming. A split die must be employed to remove the finished part. . . . FIG 9. To prevent tearing or excessive stretching on certain compound shapes a block of rubber is placed over the area where trouble may be expected. This tends to localize the blow forming the metal in that area, first, after which the block is removed and the operation continued on the rest of the sheet . . . FIG. 10. Another method for preventing wrinkles in a deep draw is to cut notches in the die mated by the punch. As the hammer drops and starts to draw the part, the notch acts to restrain the sheet in the manner of pressure rings . . . FIG 11. Where a notched die is not feasible, pieces of rubber around the edge of the die will frequently serve the same purpose. The rubber will restrain the sheet as the head of the punch is forced upon it. . . . FIG. 12. Wrinkles can frequently be prevented from forming in the sheet by laying slabs of rubber directly on the part being formed. This restricts the depth of the draw from each stroke. The rubber layers are removed one by one as the operation proceeds.













BUILT TO TAKE IT

AGAINST both the enemy and the elements America's big patrol bombers are demonstrating a ruggedness of construction without equal in the skies. Some of the most famous of these flying battleships are now built with numerous sections subassembled by Goodyear Aircraft Corporation. The skills Goodyear has learned in more than 30 years' aeronautical experience—a wide knowledge of light alloys, fabrication and stress engineering of aircraft structures—are now embodied in wing, tail, fuselage and cabin sections, stabilizers, elevators, fins, rudders and other metal-alloy parts that have proved their staunchness under fire. Today Goodyear designs and builds parts for all types of warplanes, fighters as well as bombers, and airships, too—builds them "to take it" as well as give it, to doubly insure Victory.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRPLANE INDUSTRY

1. *By building parts to manufacturers' specifications.*
2. *By designing parts for all types of planes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or construction problem.*

GOODYEAR AIRCRAFT

On the *World's Fastest "Tricycles"*

this clever tube insures safer landings

MANY of America's fastest new fighters and bombers are equipped with a tricycle landing gear, built with a full-sized wheel under the nose. It permits pilots to fly these "hot" ships in with tails up and land at speeds once thought impossible. But to avoid crack-ups it is essential that the airplane be protected against the dangers of nosewheel deflation.

This is accomplished by a clever Goodyear development known as the Dual-Seal inner tube embodying the same principle as the famous Goodyear LifeGuard. This tube has two air compartments. It is so constructed that, if the casing and outer tube are punctured, *the inner section expands and fills out the tire to normal size.* Even if the puncture occurs on the take-off, this double tube retains enough pressure to insure a safe, smooth-rolling landing after a long flight.

Today the Dual-Seal tube is protecting American airplanes and pilots, operating all over the world on makeshift desert and jungle fields. Before Pearl Harbor, tricycle landing gear was in prospect on our commercial air transports, too. Now this must wait until victory comes. But Goodyear will be ready for these great new airliners of a better world—ready with airplane tires, tubes, wheels and brakes brought to new perfection in the crucible of war.

. . .

HOW THE DUAL-SEAL TUBE PREVENTS PUNCTURE CRACK-UPS

If a thorn, cactus spike or jagged rock punctures casing and outer tube, compartment, inner section expands, forcing out tire to full normal size as at No. 2. It holds enough pressure to keep tire firmly seated on rim and maintains sufficient rolling radius to assure a safe landing.

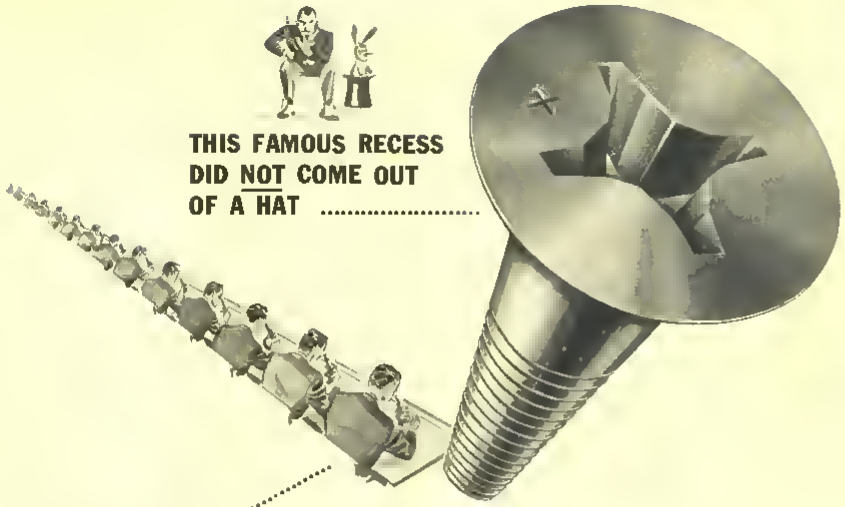


LifeGuard—T.M. The Goodyear Tire & Rubber Company





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THE GREATEST NAME IN RUBBER



THIS FAMOUS RECESS DID NOT COME OUT OF A HAT .....

The answer to .....
HIGH SPEED DRIVING
LESS WORK
TIGHTER ASSEMBLIES *took thousands of tests to perfect*

Depth, shape and taper of the Phillips Recessed Head were scientifically determined by thousands of tests. It is not just another recess — the Phillips Recess is *engineered*

The results: a screw head recessed to employ maximum turning power, thus increasing driving speed, reducing effort, improving assembly. The Phillips Screw can be set up tight without danger of splitting the screw head. Power drivers can be safely used, especially since the problem of the driver slipping out of the slot has been eliminated

Phillips cost cutting, work-speeding advantages became so apparent that now 19 manufacturers produce Phillips Recessed Head Screws to supply industry's increasing demand

Representing these sources of supply, over 200 fastening engineers offer their experience to help you use Phillips Screws to the greatest advantage. Let these experts study your fastening problem. They are qualified to recommend how to get maximum savings, through faster driving methods, smaller screw sizes, or elimination of certain operations.

Leading automotive and aircraft manufacturers have found that 50% reductions in cost and assembly time are an average saving with Phillips Screws. That is why a majority of such firms specify Phillips.

"Remember—it's not the price of the screws that counts . . . it's the cost of using them."

Speed product deliveries by saving assembly time

Specify Phillips and Save 50%

PHILLIPS RECESSED HEAD SCREWS



19 SOURCES OF SUPPLY

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

WOOD SCREWS ● MACHINE SCREWS ● SHEET METAL SCREWS ● STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS ● SCREWS WITH LOCK WASHERS

HARNESSING THE STRATOSPHERE

New units to test aircraft parts and accessories can produce atmospheric conditions simulating everything from tropics to stratosphere.

By DWIGHT TENNEY, *Ch. E., President Tenney Engineering Inc.*

PRIOR TO WORLD WAR II, the stratosphere was a place of interest to the scientist alone. He had ascended into it in specially constructed balloons, had measured its temperature, studied the increased intensity of cosmic rays, and observed its action on bacteria. The practical aeronautical engineer, flying his commercial plane at 3,000 to 10,000 ft, was only mildly interested in conditions to be met at 30,000 to 50,000 ft.

In less modern times an army occupying higher ground had a marked advantage over troops in the valley, many battles have been won by this advantage alone. Today this same advantage goes to the plane on top, and almost overnight a new series of problems has faced the aircraft designer. He has had to get his fighters and bombers higher and higher. How high is a military secret, but the obstacles he faced are not secret. The effect of thin air on propellers, the lessened resistance and air lift on the wings and fuselage—these can be mathematically calculated and checked by actual test flights.

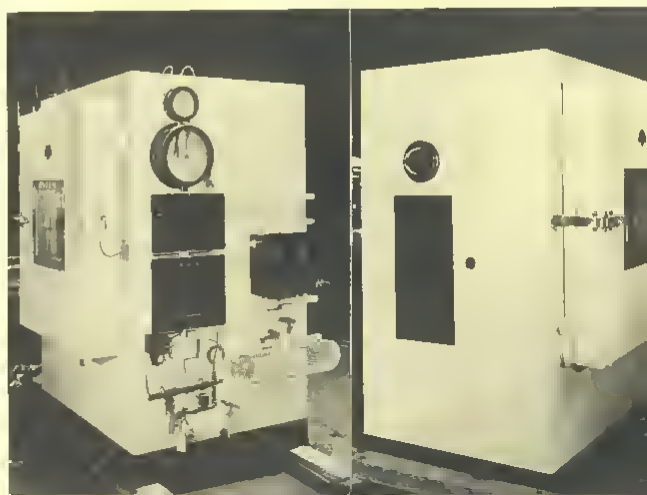
But from the aviator's oxygen helmet to his radio detector, the delicate instruments associated with flight are a different story. These units are small and comparatively light, and it was early recognized that if a small volume of the higher regions could be brought down to the shop and laboratory and made available to the research engineer and test inspector, a great saving in time and trouble could be effected. The old saying, "If the mountain won't come to Mohammed, Mohammed must go to the mountain" has been discarded, and stratosphere conditions have been brought to our engineers. Only in small pieces, to be sure—50 to 200 cu. ft.—but with them, all the potency of great height and all the changes that might be encountered from torrid, steaming jungles of the tropics to the clear dry cold at 50,000 ft.

The air conditioning engineer left his comfort cooling, his industrial processes, and climbed into the stratosphere. All the atmospheric conditions to which a plane might be subject have been reproduced: the dry tense heat of the Libyan Desert where, during the day, everything one touches is 140 to 150 deg., yet at night, water will freeze because of the dryness of the air; the frigid cold of arctic winter which freezes mercury in a thermometer and makes steel so brittle that it shatters like glass; the stratosphere, where pressure is so low that water will boil at 105 deg. F., where a ½ in. electric spark will jump 8 to 10 in. Truly, a plane today, climbing at the rate of a mile a minute, has a rough and rugged road to travel.

To reproduce these conditions in a small laboratory chamber was the challenge hurled at American scientific air conditioning engineering. One answer to this challenge has been found in the Stratosphere Chamber. This is a unit that must be carefully designed to withstand pressure as high as 1,800 lb. per sq. ft., yet be as light as possible so that minimum heat will be absorbed, a thin shell with properly designed trusses. Careful consideration is given to the windows. They must be large enough to view the entire interior. Often these windows must support a load of 5,000 lb.—the weight of an automobile on a single pane of glass—complicated by the fact that at one moment it will be 140 deg. above zero, the next, it may be 70 deg. below zero.

All openings must be carefully sealed. To stop the passage of earthly air against a pressure of 13 lb. per sq. in. is easy. A 100 cu. ft. of the air we breathe weighs 7.5 lb., but this same volume of stratospheric air weighs only 2 lb. It is extremely thin air, so thin, in fact, that it will flow through many finished aluminum castings. That the effect of altitude will not be lost, the unit must have specially designed packing glands to hold this thin air. To accurately reflect stratosphere conditions, the temperatures in these chambers must sometimes reach 70 deg. below zero. Here is a problem for the refrigeration engineer, who must deal with refrigerants, often 90 deg. F. to 100 deg. F. below zero. Cooling coils that function satisfactorily in ordinary cold storage compartments balk at stratosphere temperatures.

(*Turn to page 289*)



LEFT: Three quarter view of the Stratosphere Chamber in which aircraft parts and accessories can be subjected to any type of atmospheric condition which today's fighter planes are called upon to fly through. At top is the altitude gage and the two-pen recorder which records and controls temperature and humidity. RIGHT: Close-up of the unit, showing the glass inspection port in the front door. On side of the unit is shown the double connector panel, having 52 connector rods, the antenna lead-in and drive shaft for manual operations of units under test.

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Continuously since 1916, we have supplied propellers "of experienced design and honest craftsmanship" to aviation. Continuously building for aviation—and Victory!

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PIQUA, OHIO, U.S.A.



Ice Indicator Developed



TO PREVENT ICING UP

New electronic ice indicator developed by Minneapolis Honeywell undergoes laboratory test. The sensitive disk set in leading edge of the wing measures accumulation of ice and the unit turns on de-icing equipment at most efficient point, relieving pilot of added duty in heavy weather flying.

A new electronic ice indicator which measures the amount of ice forming on aircraft surfaces and automatically turns on de-icing equipment has been developed by the Minneapolis Honeywell Regulator Co. The instrument was developed at the request of Northwest Airlines, and is expected to prove of value to military as well as civilian operations.

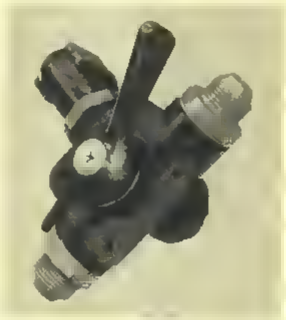
The unit can be set to turn on the de-icers at any predetermined thickness of ice, and is said to measure accumulations within 1/8 in. It comprises three units: a pick-up plate or "sensing element" placed in the leading edge of the wing, an amplifier and a power supply unit. The sensing element is a small plastic disk set flush in the plane surface and contains parts to actuate the mechanism by measuring the ice accumulation. This element, which need not be in contact with the ice but can be installed beneath the de-icer, is connected with the amplifier inside the wing. This, in turn, is connected to the power unit which actually controls the de-icing equipment and sends impulses to an indicator on the instrument panel. The unit weighs less than 5 lb. and takes up little room.

Valves Save Strategic Material

Savings of approximately 83 percent in machine tool time and over 50 percent in materials have been effected in manufacture of standard three-way plug valves now used in military aircraft by the Pressure Mold casting process developed by the Hydraulic Division of Harvill Corp.

Formerly the plug valves were produced from forged stock, with large amounts of hand and automatic screw machine operations necessary. Under the new process, even such parts as the screw plug in the end of the valve are

(*Turn to page* 143)



MATERIAL-SAVING VALVE

Standard three way plug valve produced by Pressure Mold casting process, which saves 50 percent in materials and approximately 83 percent in machine tool time.

The B.F.Goodrich Airplane of the month

BELL AIRACOBRA

BOLT OUT OF THE BLUE! It's the famed Bell Airacobra, a clean, swift "Cannon on Wings" that packs the wallop of a 37 mm. anti-tank cannon in its nose, and 30 cal. and 50 cal. machine guns in its wings. For months Airacobras have been in the fight, furthering our cause, doing our nation proud. New planes are streaming off the Bell lines by the hundreds. And many B. F. Goodrich products, including the famous Airplane Silvertown Tires, are helping to "Keep 'em Flying." This month, B. F. Goodrich salutes the Bell Airacobra, a great plane, with a great record of service in many a combat!

The Army flies with
B.F.Goodrich
FIRST IN RUBBER

B.F.GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*



Conductive tail wheel tread "grounds" static electricity

AS MENTIONED io a previous article, static electricity is generated by a plane io flight Wheo a plaoe laods, its three points of contact are the tires, which, when made of ordinary rubber, act as iosulators.

Thus, the static electricity is oot discharged and can cause the anooyance of shock to passengers or crew Furthermore, there is a chance of the electrical discharge causiog a spark duriog refueling

To overcome this situation, B F Goodrich set out to develop a tail wheel which would conduct static electricity off a plane as soon as it touched the ground.

Carboo black, being a good conductor, was experimented with The carboo black cooteot of tail wheel treads was increased But the solution of the problem was oot an easy one For, by iocreasiog the carboo black cooteot of the tread aod thus stepping up its conductivity, tests showed that the tread wore badly and flex-cracked.

New aod better types of carhoo black were developed that made it possible for B F Goodrich eogineers to produce a tread which had all the desired qualities of durability aod, at the same time, acted as a cooductor. Now B F Goodrich Tail Wheel Tires in use are electrical cooductors Wheo a plane uses these tail wheels, the static electricity leaks off upon contact with the groood. This special cooductive tread offers advantages for military as well as commercial aircraft. The B F. Goodrich Compaoy, Aerooautical Division, Akron, Ohio

MAKERS OF B. F. GOODRICH TIRES AND OVER 50 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

LET'S GO! U.S.A. KEEP 'EM FLYING!

ELECTRICALLY CONDUCTIVE TAIL WHEELS *made by B. F. Goodrich*



CONDUCTIVITY IN A TAIL WHEEL TIRE is indicated by a simple test. Voltage is applied to an electric light bulb in series with two contacts on the tire The relative conductivity of the tire will be shown by the intensity of the light produced



WHEN THIS LOCKHEED-HUDSON MEDIUM BOMBER makes a landing, its B F Goodrich Tail Wheel Tire comes into contact with the earth This tire dispels the electrostatic charge which has built up oo the plane during flight



In war or peace

B.F.Goodrich

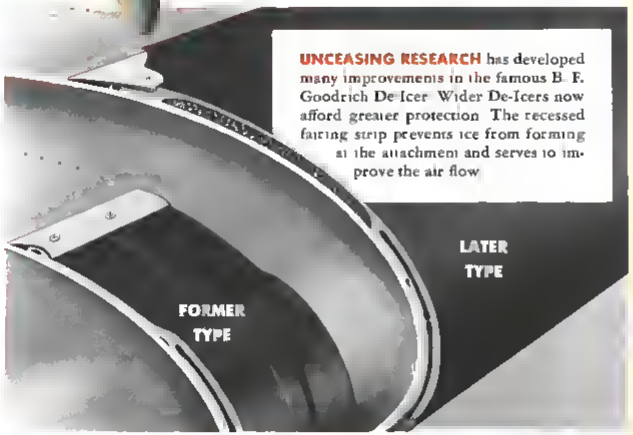
FIRST IN RUBBER

From the B. F. Goodrich Notebook

PRODUCTS THAT 'defy the elements' are one of the most important contributions to aviation made by the B F Goodrich Aeronautical Division Here you see a Feed Shoe being inspected on a typical three-bladed propeller This rubber product makes it possible to bathe the whirling blades of a propeller with protective anti-icing fluid



RIVNUTS, the B F Goodrich hollow rivet which can be upset from one side, can now be installed at greatly increased speed with a newly developed power tool Write for the new handbook which has just been issued for designers and engineers



UNCEASING RESEARCH has developed many improvements in the famous B F Goodrich De-Icer Wider De-Icers now afford greater protection The recessed fairing strip prevents ice from forming at the attachment and serves to improve the air flow

B.F.GOODRICH • AERONAUTICAL DIVISION • AKRON, OHIO



BRIDGE FOR SERVICING LIGHTING FIXTURES

Overhead bridges suspended from existing crane rails have been adopted by the Vega Aircraft Corp Burbank Calif, as a permanent means of servicing fluorescent lighting fixtures Constructed of angle iron and wood, the bridges roll along the overhead crane rails carrying replacement tubes and parts and providing means for efficient cleaning and servicing of the fixtures They were constructed at a cost of about $300 each

maule, with only thread milling operations necessary on the casting prior to installation

Aluminum alloy 13 X is used for all parts except the plug which is pressure mold cast from manganese bronze.

New Surface Milling Method

Increased production rates are reported possible by a new method of surface milling known as hyper-milling, in which the metal is sheared off rather than ploughed off as in conventional methods

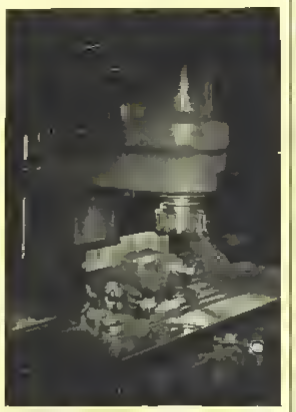
The process uses Firthite sintered carbide tipped inserted blades with both the rake and helix angles of the mills negative up to 10 deg, with the cutters operating at speeds up to ten times those normally used and with resulting feeds up to six times those of conventional high speed mills on hardened alloy steel parts.

The process is reported to result in burnishing the surface of the work being milled, producing less tool wear Both tool and work are said to be kept cooler, resulting in a minimum of distortion. It is said to be particularly adaptable to hardened, heat-treated steels, including alloys which present difficult milling problems.

Bomber Turret Costs Cut

Improved manufacturing techniques have resulted in reducing costs of bomber turrets by more than 30 percent and production has been increased at the new Briggs turret plant, W P Brown, president, reported during inspection by Lieut Gen Henry H Arnold, Chief of the Army Air Forces

Although the plant was completed only last May, it is 53 percent ahead of schedule established by the AAF, and shipments currently are running at rate of several million dollars worth per month July production was 100 percent more than the original promise.



NEW TECHNIQUE FOR MILLING

The hyper-milling process in which both rake and helix angles of blades are negative up to 10 deg Illustration shows cutter in action on annealed alloy tooled steel at 418 r p m with 1/16 in depth of cut and feed of 5¾ in per min.

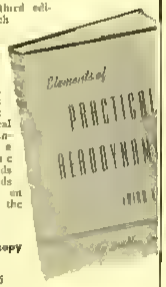
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from this book It is very seldom that this subject is handled in so uniquely simple a way.

ELEMENTS OF PRACTICAL AERODYNAMICS

By BRADLEY JONES M.S.
Professor of Aeronautics, University of Cincinnati

This is the new third edition of a book which has already been endorsed by thousands of enthusiastic users It has the simple direct treatment of each subject that makes a technical book thoroughly practical both for the beginner who wants a textbook and the specialist who finds that he often needs a good reference on the elements of the subject



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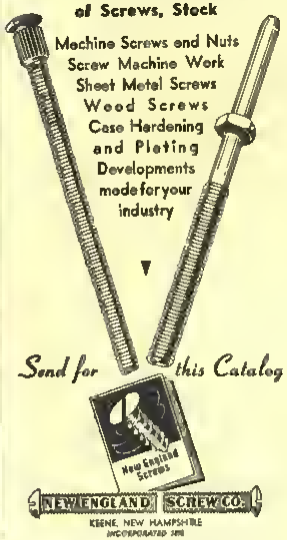
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PROLONG Tool Life!

Tools are precious these days. To insure long life they should be kept in good condition by proper use and maintenance. For best results, follow makers' directions in handling and repairing. And for safe storage of tools, as well as utility in production, have Penco Tool Units on the job!

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No. 34-T

All welded steel for heavy-duty use. Sturdy drawers and doors with locks. Ample storage space for tools, parts, instruments, gauges, providing protection against fire, theft, dirt, moisture and abuse. Tops can be used as benches. Suitable for 1, 2 or 3 shift operation.

1869 Penco

War Industries— write for details and prices

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32 Oregon Avenue, Philadelphia, Pa.



NEW SHADOWLESS LIGHTING

New lighting system which will be used in aircraft plant now under construction which eliminates localized lighting, direct and indirect glare and shadows. Made possible by 3,000 watt mercury vapor lamp developed by Westinghouse, the working model shown illustrates how shadows under wings are eliminated. By obtaining reflection factors for white ceiling and floor of 75 and 65 percent respectively, 35 candles of illumination is provided below the aircraft eliminating need for localized lighting.

Tinless Oil Can Developed

A fiber container, said to be the first that is impervious to oil, has been made available to industry by the Macmillan Petroleum Corp. to insure continued delivery of lubricating oils in sealed containers.

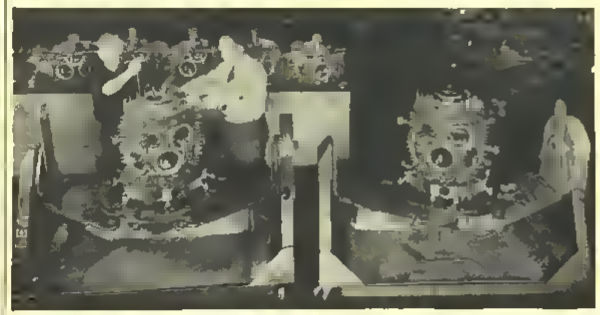
The result of five years of research, the new container is being produced by the Macmillan company by direct processing of such crops as corn and other grains, flaxseed, tallow, animal tissue, bone and clay, with the basic material made from straw and waste paper.

In designing the new container the full quart capacity has been maintained but the diameter has been reduced and the height correspondingly increased.

Engines Pass Change-Test

In the third "interchangeability" test Pratt & Whitney engine parts made by the company itself and parts made under license by Chevrolet were assembled into two complete engines and subsequ

(*Turn to page 147*)



"COMPOSITE ENGINE

Pratt & Whitney engine parts built by the home organization are assembled with parts made under license by Chevrolet Motor Co. After successful "green test" runs and tear-downs which proved interchangeability of parts the "composite" engines were re-assembled and shipped for war duty.

TINNERMAN *makes the* FASTENINGS...



AIRCRAFT KEEP 'EM FLYING

for faster Aircraft Assembly

Illustrated here are a few of hundreds of different types and sizes of aircraft fastenings—all developed by TINNERMAN for FASTER AIRCRAFT ASSEMBLY. They reduce assembly operations, conquer vibration loosening, save weight and lower net costs.

All engineered with the high quality of the SPEED NUT SYSTEM, these fastenings also reduce the number of parts, eliminate many hand tool operations, facilitate blind location assembly and simplify every operation in which they are used.

For prompt action on samples and engineering details, attach this ad to your letter indicating part and size desired.

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New!

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TODAY, when industry is facing the problems resulting from conversion, faster production, greater accuracy, elimination of waste, and replacement of critical materials, X-ray inspection is providing many of the answers.

The Kelley-Koett Mfg Co.—pioneer creators of quality X-ray apparatus since 1900—has developed this new combination to meet industry's urgent need.

This unit provides, conventional radiography for the inspection of castings and welds, microradiography for investigation of alloy compositions and other materials, X-ray diffraction analysis for the laboratory study of crystalline structures.

Portable and compact it can be moved anywhere in the plant and used inside fabricated assemblies. It is easily adaptable for stationary or assembly line inspection or research work in the laboratory, and supplies industry with a long wanted X-ray inspection tool of wide application. For more detailed information consult Keleket X-ray engineers.

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RADIOGRAPHS *made with this unit!*

SPARK PLUG



This is a radiograph of a spark plug which is used on aircraft engines. The purpose for radiographing this spark plug was to show the manner in which the interal electrode had been assembled inside of the plug. The main interest lies around the copper gasket at the upper and lower ends of the ceramic insulator which forms the internal structure of the plug. So far as we can determine, there are no defects in the assembly.

⅝" THICK WELDED STEEL PLATE



This is a radiograph of a ⅝" thick welded steel plate. The radiograph readily shows that the weld has not been complete throughout the section of the plate. This fact is indicated by the dark line running through the center of the radiograph. The darker area on either side of this line indicates that the weld has not been built up into a bead on top of the plate, but instead the plate has considerably less thickness at the junction of the weld than throughout the rest of the area.

COMBINATION INDUSTRIAL UNIT

PIONEER CREATORS OF QUALITY X-RAY EQUIPMENT SINCE 1900

ted to a "green test" run and found to be satisfactory in every way. After the tear-down, following the green test, the engines were re-assembled in the composite form, given a final test run and shipped for war duty.

In previous engine tests, parts from engines made under license by Buick and Ford were mixed with those built by P & W, and in both cases the "composite" engines were found to have met all requirements satisfactorily.

A similar test was also conducted recently by another United Aircraft division, when Hamilton Standard propeller parts made by the home organization were assembled with those made under license by Nash Kelvinator and found to make properly functioning assemblies.

New Research Organization

Farnham Manufacturing Co., specializing in engineering and manufacturing of machine tools for aircraft wing production, has separated its research activities completely from manufacturing due to necessity for secrecy in research and to provide facilities for development work unaffected by production schedules.

Paul Duboscarl, former president of Farnham, has been elected president of Paragon Research Inc., which has taken over all development work for Farnham. Other Paragon officers are Roland Georget, secretary, and Howard C. Reimann, treasurer. Farnham officers now are: Frank L. Boutet, president and treasurer; Arkan E. Farnham, vice president; and Edward L. Keenan, secretary.

All efforts of Paragon will be supported by Farnham and, for the duration, war problems only will be considered.

Quality Control Chart

A standard "Control Chart Method of Controlling Quality During Production" has been completed by the American Standards Association as the third in the series of aids to maintaining quality in quantity production.

The new standard shows how a manufacturer can keep constant check on a production process by means of a quality control chart, which carries a pair of control limits which serve as a criterion in determining whether production is running smoothly or whether trouble is brewing. These limits are computed from quality measurements made on a number of samples of a product, which may run all the way from aircraft rivets to cloth. Once they have been placed on the chart, the manufacturer continues to take samples at regular intervals and a point representative of the quality of each sample is plotted on the control chart to determine whether it comes within the control limits.

Tool Life Increased Sharply

A new, strategic material-saving process in cutting tools, applicable to all industries using lathe tools, has been developed and is being made available to the industry by Wright Aeronautical Corp., according to an announcement by Myron B. Gordon, vice president and general manager.

Tests in which more than 100,000 alloy steel forgings were machined show that gains up to 2,000 percent in tool life are possible on high speed steel lathe tools by grinding and honing the cutting tools to a highly polished finish and by using a new form of tool to break up chips and shavings.

Specially designed tools hold the cutting tools for automatic grinding 18 at a time and additional fixtures hold single tools for a slight final grind on a fine stone, followed by an ultra-fine polishing operation.

In addition to the savings in strategic materials, the new process saves vital man hours in removing and hand-grinding tools.

RYERSON



Reliable Source of Supply for SPECIAL AVIATION STEELS

Specialized skill and experience built up in 100 years of steel-service to American Industry—vast tonnages of steel which move steadily through ten great Ryerson plants into war production—are at aviation's command.

For example, recently eighty seven bombers were held up awaiting delivery of 2⅜" rounds of WD-X4130. A Ryerson Steel-Service man was called at his home on a Sunday evening. Within a matter of minutes, Ryerson stocks in ten cities were being checked. All were temporarily out of the desperately needed bars—all but one.

A shipment of 2⅜" WD-X4130 rounds was just arriving at one of the Ryerson plants. The car was immediately opened and the same evening the steel was on its way to the airplane builder. A production bottleneck was broken.

When steel is needed in a hurry—and it often *is*, under pressure of war production—*call Ryerson!* If the required steel is to be had anywhere, Ryerson can, and will supply it!

JOSEPH T. RYERSON & SON, INC.
Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

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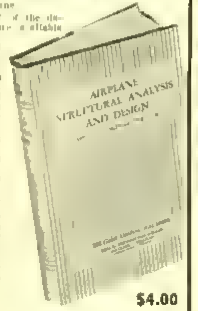
when you keep *learning*

An l[illegible] of [illegible] engineering in technical schools [illegible] the best way to see what this new book can do for you about air structures

The first problem confronting the designer of the structural part of an airplane is to determine what loads are to be expected in life of the ship and how these loads are to be [illegible] This book by Sechler and Dunn not only helps you [illegible] but also gives you [illegible] methods of [illegible] with numerous tests and examples to show how the [illegible] are used in practice

The second need of the designer is to have available [illegible] design methods for structural elements subject to [illegible] combination of loads Part II is concerned chiefly with this phase of the problem

Part III of this work gives a short discussion of the [illegible] of an airplane [illegible] various structural types Advantages and disadvantages of each type are listed and [illegible] the lightest and most economical [illegible] best suited to his job



$4.00

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CITY AND STATE [illegible]

EMPLOYED BY [illegible]

A 6 42

REVIEW OF PATENTS

FOLLOWING are digests of the more significant of recent patents on aviation developments announced by the U S Patent Office

Means for Indicating Turning Movements of Craft, 2 281 833 T W Konvon assignor to Sperry Gyroscope Co Inc A device which visually indicates turning movement or deviation to the operator of an aircraft in such manner that the operator may instinctively correct the course of the craft through the same instinctive reaction which would be created by observing a fixed or stationary object with relation to the turning movement of the craft.

Controllable Propeller, 2 281 953 T A Dicke A speed responsive centrifugal governor type of automatically controlled variable pitch propeller having means which can be set from outside the hub for setting or adjusting the predetermined speed at which operation of the speed responsive means becomes effective

Universal Flight Instrument 2 282 036 W McKay assignor to Sperry Products Inc An improvement in attitude of flight indicators of angularity emphasis for eliminating errors due to accelerative forces whereby the pendulosity of the stabilizer is automatically altered in response to no acceleration forces in excess of a predetermined degree

Hangar or Like Shelter More Particularly for Aircraft 2 282 [illegible] W C Gunn and G R Dunbar An easily and quickly erectable hangar for lighter planes which requires no excavated foundations may be readily enlarged and which permits quick egress from either end Provides also for all-metal pursuant Consists essentially of prefabricated sections.

Propeller 2 282 088 L E Reid A propeller provided with one or more yieldable pawls so the pressure face of the blades to serve as shock absorbers or automatic cushioning means

Control Levers 2 282 091 M B Rhodes assignor to The Oilgear Co Milwaukee A system of coordinated control levers for regulating fuel and air mixtures by which the mixture is automatically established when ever the throttle lever is moved to idling position in order to avoid engine stalling and of the levers having a transmitter and a hook to engage another of the levers.

Aircraft Ground Speed Indicator, 2 282 [illegible] H F Olson, assignor to Radio Corporation of America An improvement in direct reading indicators for day or night operation Utilizes an optical screen a vibrating light slit fashioned to a tuning fork vibrator providing at a constant frequency and an ammeter

Means for Driving the Propelling System of Aircraft 2 282 [illegible] H P Lessard assignor to Sucker Products of Ohio Fairfield Ohio Gun Gas Electricity Launch S A A motor generator of the free piston type mounted in the wings of the plane being part of a recoiling machine fed with driving gas under pressure for driving the propelling system of the aircraft, to eliminate the use of variable pitch propellers and change speed transmissions at the same time permitting any desired regulation of the power of the unit independently of the speed of the propeller

No. 2,273,914, to Marcel Wallace Panoramic Radio Corp. Navigating system Transmitting on unmodified radio frequencies which whose carrier frequency varies periodically within predetermined limits the rate of carrier frequency variation being predetermined and the limits of frequency variation being characteristic for each of several stations all of which operate within a given frequency band Visual means for individually and simultaneously indicating within the frequency spectrum the respective limits of frequency variations of each of the several signals

Variable Pitch Propeller, 2 282 [illegible] F M Thomas assignor to The De Havilland Aircraft Company Ltd An improved control for variable pitch propellers whereby braking or arresting of rotation may occur automatically with the operation of feathering and whereby the propeller may be braked quickly when feathered, in case of engine failure

Retractible Airplane Wing 2 282 [illegible] F Burnham Chapman A telescopic construction wherein the fixed wing member is internally supported by the movable section while in retracted position the auxiliary wing member having a slotted skin to receive the spars of the main member when retracted and having means of closing the slots when extended.

Parachute Harness, 2 283 [illegible] J W Horning assignor to Buckling Parachute Harness Co Inc The parachute engaging straps are so mounted that when they are subjected to a jerk as the parachute opens they will cause the occupant to be suspended in substantially a seated position thus removing strain from the leg straps and the waist strap and permitting the buckles thereon to be easily released before a landing is made

Ground Speed Indicator for Aircraft 2 283 [illegible] H L Johns Lexington to Kansas City Testing Laboratory An instrument designed to indicate on a dial the speed of an object passing between two given points in the field of view beneath an airplane whereby after running for absolute elevation the ground speed will be indicated

Universal Indicator for Aircraft 2 283 [illegible] W Ansorge assignor to Sperry Gyroscope Company Inc An attitude indicator for aircraft, which shows in one instrument and on one face the attitude of the craft in all three planes, that is the fore and aft inclination or pitch its lateral inclination or roll angle, and its course or heading in azimuth

Gyroscopic Horizon, 2 283 [illegible] L F Carter assignor to Sperry Gyroscope Company Inc A device applicable to any gyro-vertical for automatically erecting a gyro vertical to the line vertical and for holding it there under all conditions of roll, pitch and yaw of the ship on which the instrument is carried.

Remote Control for Landing Gear and Flaps 2 283 [illegible] R A W Filmer assignor to Air Associates Inc A device to effectuate unintentional operation of the retractible landing gear and permit coordination of the landing gear and flaps, including a safety means to make retraction dependent upon the attainment of a substantial air speed, the controls being grouped in a single unit and the locking an interlocking means to insure lowering the undercarriage for landing whenever the flaps are lowered to reduce the air speed for landing

Propeller for Aircraft 2 283 [illegible] H Sikohl The blade is built on a root portion formed with a transverse shoulder and slots of high tensile strength are wrapped around said shoulder and extending therefrom over the whole or a large portion of the length of the blade and fixed thereto The interspiral core glues the strips and is made of balsa wood or similar material

Aircraft Transmission, 2 284 [illegible] R Chilton and W M Shoal assignors to Wright Aeronautical Corporation A system of multiple pinions and shafts engaging common gears on the engine and propeller shaft respectively for driving propellers on the wings of an airplane from an engine mounted in the hull or fuselage The shafts are unusually slender and are enclosed in slender tubes to accommodate wing deflection without use of universal joints

Tailless Airplane 2 283 [illegible] M E Gluhareff assignor to United Aircraft Corporation The craft is of the pusher type and the power plant is pivotally mounted to allow for tilting the propeller in positions of take-off or landing The wings are inclined forward and the outer tips are movable to compensate for the tendency of the center of lift to move rearward when the wing is changed to increase its lift coefficient.

Duel Purpose Parachute Pack, 2 283 [illegible] S M Ballou J J Galloway and E W Smith. A pack designed primarily for use

(*Turn to page* 151)



ONE OF THESE BOOKLETS *may break that inspection bottleneck*

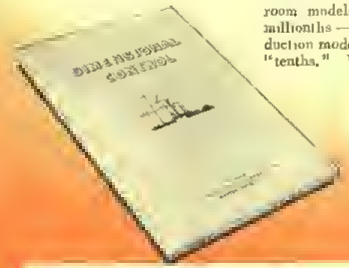
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"SHEFFIELD GAGES"—An 8 page digest of the Sheffield line of instruments, this booklet should be in the file of every key person concerned with gages and inspection. Included are descriptions of the gages mentioned previously, as well as the Sheffield Thread Lead Checker, the Sheffield Universal External Measuring Instrument, and the Sheffield Universal Internal Measuring Instrument.

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THE PUMP THAT Improves WITH USE!

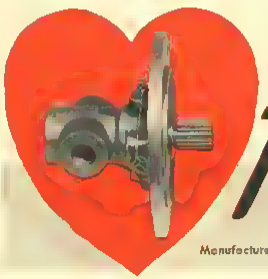


The cardinal principle on which ROMEC pumps operate is the off-set rotor revolving two rocker-sealed thru-type blades within a developed bore, the one-piece blades moving back and forth through accurately machined rotor slots.

The ends of the sliding blades are machined with a half-round groove. Into these grooves are fitted metallic packing bars called *rockers* because they rock back and forth with a wrist action. The broad face of the rocker is always against the bore wall.

As the rotor turns, the wrist action not merely maintains a broad, continuous contact with the bore-wall, but also makes the rocker and blade self-adjusting, constantly keeping the pump more dependable in performance.

As the crew cannot perform better than their hearts, so the planes and motors cannot perform better than their pumps





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of parachute troops which may be opened either manually by means of the usual rip cord or by a static line attached to the plane. A special feature is a static rip cord pin holding means which will be operative should the line be pulled in any other direction than in a straight line.

Hollow Metal Propeller Blade, 2,295,801. F. W. Caldwell, assignor to United Aircraft Corporation. A metal blade having relatively thin metal walls reinforced by internal struts or web members. All portions of the core member which contact and are secured to the cover member are brought to a feather edge to avoid localized highly stressed areas.

Airplane Step Structure, 2,294,800. L. E. Reisner and O. G. Blocher, assignors to Vultee Aircraft, Inc. A pair of conjointly shiftable ladders which fit within fuselage-shaped pockets in the bottom of the fuselage to eliminate drag and which swing back and forth into or out of position. When extended they can only be moved by shifting the control element which is located inside the plane.

Sound Transmitting Means for Aircraft Sonic Altimeters, 2,294,208. H. Rohn and H. Schadlmann, assignors to Siemens Apparate und Maschinen Gesellschaft mit beschrankter Haftung. A device for producing a sound impulse of adjustable duration whereby sound impulses may be produced which will not overlap at low altitudes and which enables accurate altitude measurement at both high and low altitudes.

Position Repeating System, 2,294,218. H. C. Boiers, assignor to Fairchild Aviation Corporation. A system having a sensitivity which is theoretically unlimited and is practically limited only by economic considerations and in general, having a sensitivity and an accuracy of high order particularly suitable in position repeating systems in which the controlled member requires a considerable amount of torque and power.

Airplane Wing and Fuselage, 2,294,220. F. S. Beal. The wing structure is molded of die coal and the plane is made in three sections comprising a forward power plant assembly, a mid assembly and a center wing section. The lower portion of the cabin is provided in the wing structure.

Aircraft Air Pump, 2,294,280. R. R. Chrlis and T. R. Thoren, assignors to Chrlis Pump Company. Air pump and drive so arranged that it will absorb the torsional whip of the plane engine, allow for considerable misalignment between the engine and pump shafts, operate with equal facility in either direction of rotation, provided with an improved lubricant metering system.

Landing Gear, 2,294,407. C. R. Lemanier, assignor to Fleetwings, Inc. A self locking device which will immediately lock the gear when it reaches the end of its travel in either position, and which is automatically released only when the hydraulic actuating mechanism has been set in motion to move the landing gear.

Means for Preventing the Formation of Ice on Aircraft, 2,294,501. R. McCleaan and E. G. Marshall, assignors to Constant Speed Airscrews Limited. The nose or spinner of the plane is of a casing type filled with anti-freeze. Means is provided for spraying the propeller. The device is automatic to temperature variation.

Ground Gear for Airplanes, 2,294,600. J. P. C. Irander. The invention resides in an improved caster wheel employed on a tail wheel which will caster when the plane is hauled up on the ground. It is steerable and may be installed in present planes or built into new planes.

Variable Pitch Propeller, 2,294,607. D. H. Buttrill, assignor to Canadian Car & Foundry Company Limited. A simplified construction of variable pitch propeller suitable for both large and small planes. It is based on utilizing variation in speed of rotation to automatically control blade pitch for all flying conditions by making change in pitch a function of change in speed of rotation and changing this function at three different points in a complete rotary speed cycle.

Variable Pitch Propeller, 2,294,585. D. H. Buttrill, assignor to Canadian Car & Foundry Limited. A variable pitch aircrew light and inexpensive enough for use on small airplanes in which changes in pitch are controlled by the engine throttle, the correct pitch being automatically obtained by substantially the ordinary throttle manipulations.

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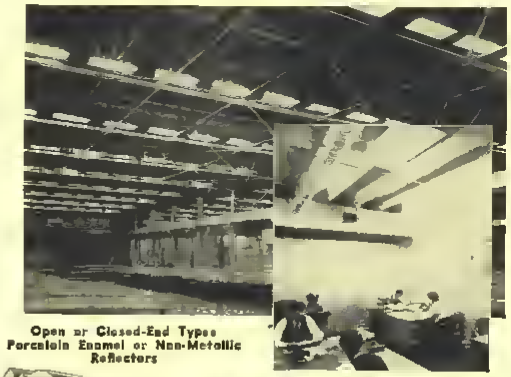


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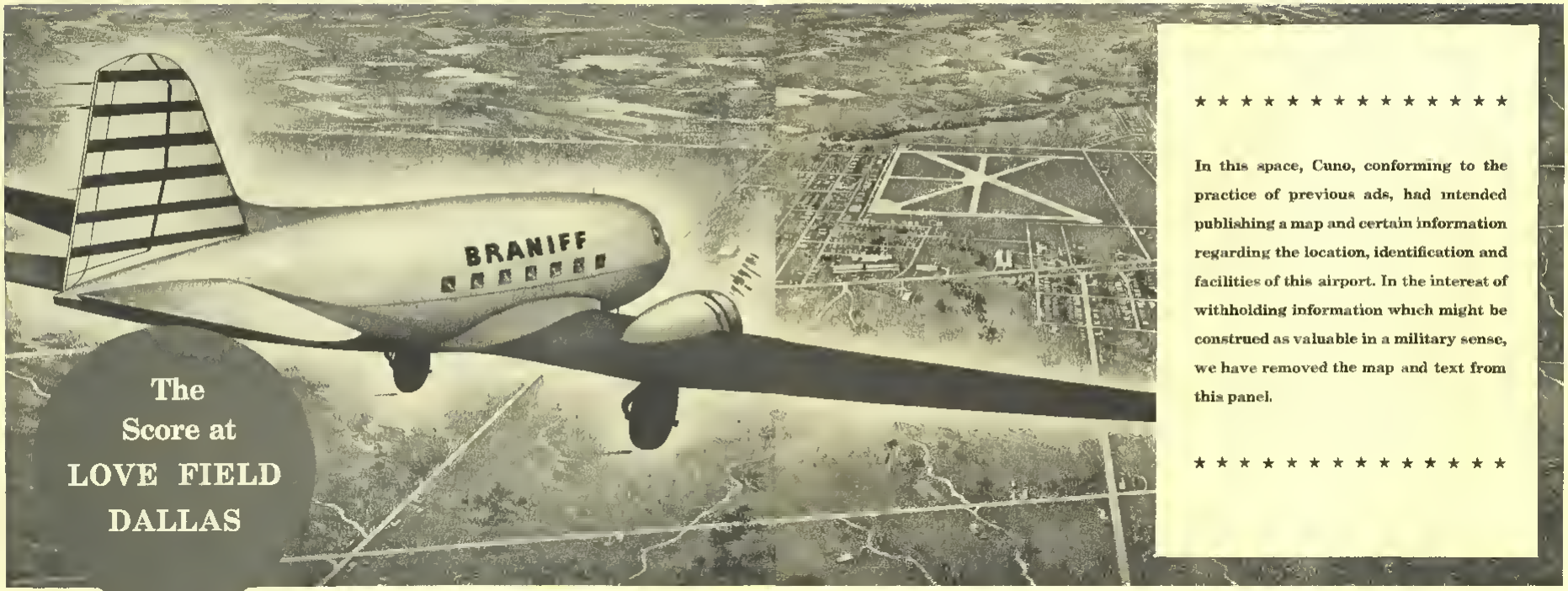
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The Score at LOVE FIELD DALLAS

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

In this space, Cuno, conforming to the practice of previous ads, had intended publishing a map and certain information regarding the location, identification and facilities of this airport. In the intereat of withholding information which might be construed as valuable in a military sense, we have removed the map and text from this panel.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

40 Flights ... 40 Planes have fluids protected by CUNO FILTRATION

There is a daily average of 40 flights by three airlines at Love Field, Dallas — headquarters for Braniff Airways, terminal for American Airlines and Delta Airlines. 100% of these planes have installations of Cuno Filters.

YOU engine and aircraft builders have real faith in the Cuno Filter. You must feel that it is the most dependable means of keeping fluids clean — at high speeds, at high altitudes, for long periods of time.

For you have been practically unanimous in your choice of Cuno.

Cuno was in on the ground floor of aircraft engine lubrication. Engine builders recognized it as an opportunity to insure further against failure due to contaminated fluid or clogged fluid lines. And in the succeeding years, Cuno engineers have satisfied many other aviation requirements.* Today, the demands of engine and aircraft builders are largely responsible for the tripling of Cuno's manufacturing facilities.

* Among them the Cuno self-cleaning filter. See illustration at right.

From Drafting Room to Maintenance Shop

The Cuno engineer serves the industry in many ways: designing filters for individual applications; aiding aviation designers in building Cuno Filters into their blueprints; servicing the ultimate operators of the aircraft.

That is why Cuno engineers are familiar figures in drafting rooms, near assembly lines, on proving grounds, in airport maintenance shops.

If your responsibility is the protection of lubricated or fluid controlled parts, the selection of a Cuno Filter will be in line with the entire industry's best judgment.



Completely Automatic Filtration

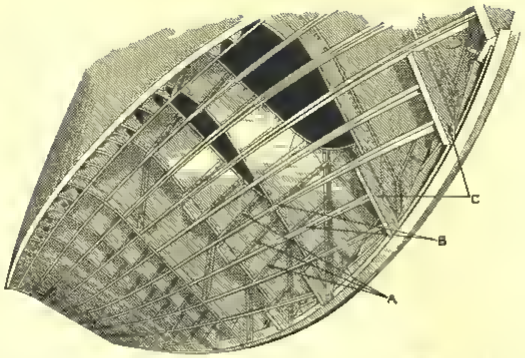
Cuno's self cleaning filter was developed with the assistance of prominent aviation engineers. A tiny hydraulic motor, powered by the oil it helps to keep clean, rotates the filter element continuously past cleaner blades which positively comb out imbedded as well as adherent solids. Fluid systems equipped with Cuno's self turning filter are kept free of sludge and undesirable solids, at all times and with occasional cleaning out of the sump the only attention required.

KEEP FLOW ON "GO" WITH CUNO

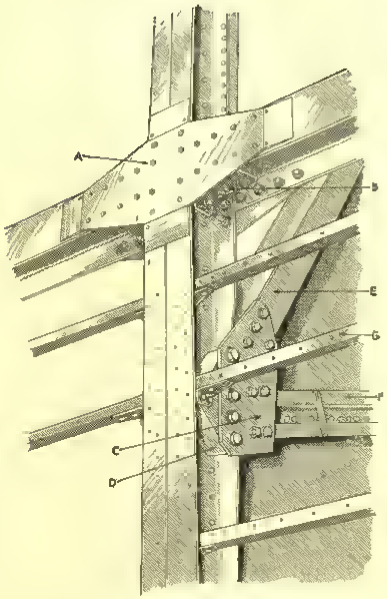
THE "FILTER-FINE" STRAINER

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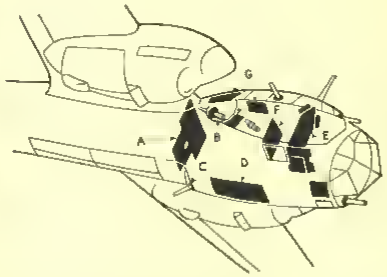
SKETCH BOOK of Design Detail



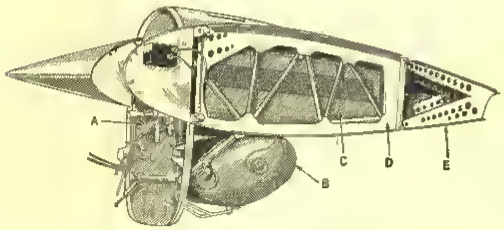
The hull of the Vought Sikorsky VS-44-A clearly resembles surface ship construction but there are however many points of interest that are used in aircraft hull construction Some of them are the use of reinforcing stringers A placed at right angles to the points where the stringers B are attached to the bulkheads as a means of distributing landing loads Note also the gusset plates C attached to the nose bulkheads to absorb any concentrated load applied at these points (Also see Aviation's Sketch Book for March May and June 1942)



A typical intersection of a bulkhead and longeron of the Vought Sikorsky VS-44-A is shown above At this point a gusset plate A is faired in and bolted to both members. The longeron is also connected to the bulkhead by two angles one on the top and one at the bottom of B, both of which are also bolted in place Note in the lower part of the sketch the gusset plate C and the pyramidal member D reinforcing the joining of two cross members, E and F, at the bulkhead and a stringer G.



The cutaway above shows the armor arrangement of the German Do 17z and 215 which carries six machine guns, upper and lower front upper and lower rear and one to each side The bulkhead A inside the fuselage is designed to give protection from behind to both the upper rear gunner firing the gun B and the lower rear gunner firing the gun C The armor plate D is designed to give protection from below to both the lower and upper gunners. The armor E fits around the pilot's seat Note also the small pieces designed to protect his head The bulkhead F is additional forward protection for the rear gunner while the smaller plates G give head-and shoulder coverage (See also AVIATION, August 1942 page 196)



At left is shown a cross-section of a Handley Page "Halifax" bomber wing at the right outboard engine nacelle with many of the engine connections already in place through the firewall 'A' The self-sealing fuel tanks B and C are provided with flexible hose jettisoning systems Note the 'built-up rib 'D' as contrasted with the section E aft of the rear spar (For other Halifax details see AVIATION'S Sketch Book for February 1942)

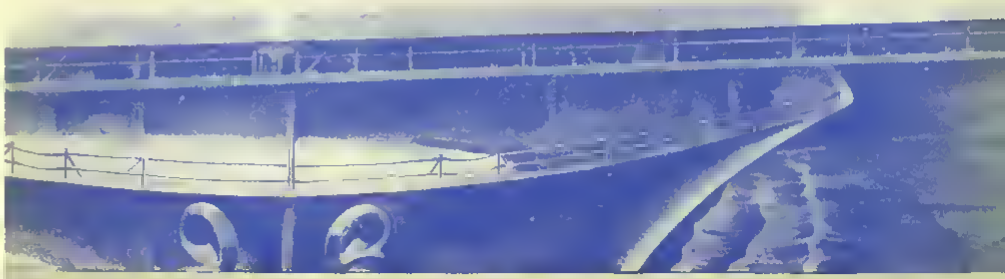
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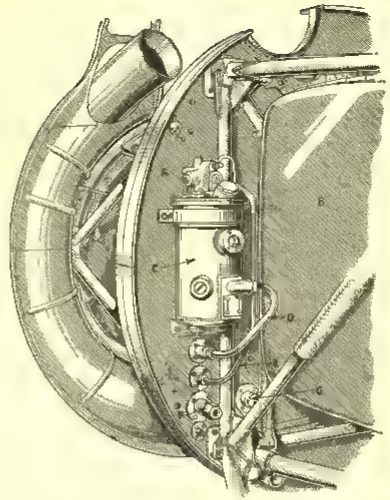
NOW-

Minutes... not Days for Repairs!

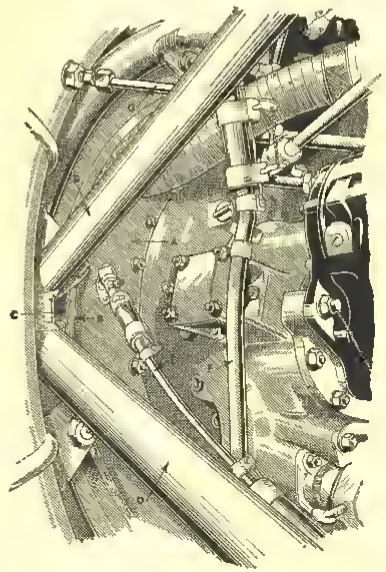
AEROQUIP SELF-SEALING COUPLINGS AND HOSE LINES, WITH DETACHABLE FITTINGS, SAVE VITAL TIME IN REPLACING AND REPAIRING ENGINES, WHEELS, BRAKES, AND OTHER UNITS.

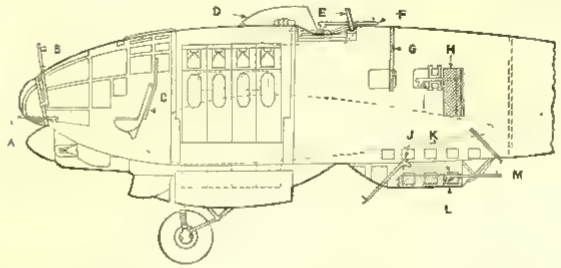


AEROQUIP SELF-SEALING COUPLINGS



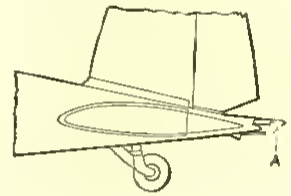
Each of the four engines of the Vought Sikorsky VS-44A has two firewalls as shown in the illustration above. The conventional wall "A" is between the oil tank "B" and the engine accessory compartment. "C" is the automatic pilot tank. "D" is the line from the tank to the hydraulic pump mounted on No. 3 engine while "E" is the line from the pump to pressure regulator on the pump. "F" is the inlet line going through the firewall and "G" is the fire extinguisher line. The illustration at right shows a detail of the forward firewall which seals the accessory compartment from the cylinders and exhaust manifold. The diaphragm "A" is bolted to the engine and its outer edge forms a 45 deg. angle to which is fastened a layer of asbestos "B". This forms a seal by pressure against the diaphragm "C" which is attached to the cowl support ring. The engine is attached to the mount "D" by shock absorbing rubber cushions while the exhaust collector ring and cowl wall are attached direct to the mount itself. Thus vibration of the engine through the diaphragm "A" is absorbed by the asbestos while still maintaining an effective fire seal. The manifold pressure line is shown at "E", the vacuum line for instruments at "F" and the fire extinguisher line into the cowl wall at "G".

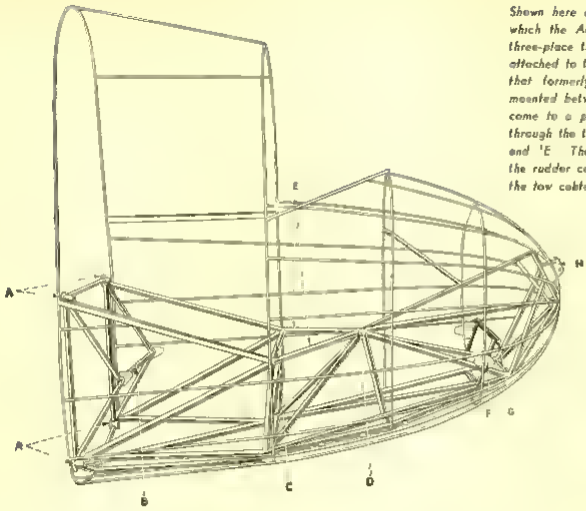




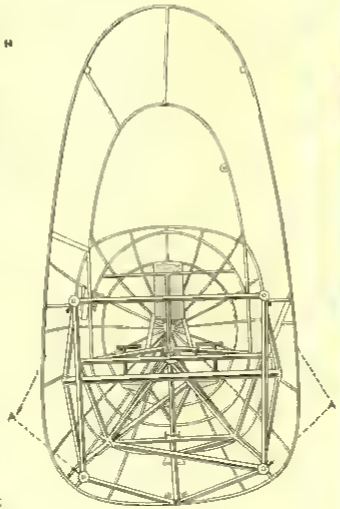
The armor and armament details of the Heinkel He 111 twin-engine bomber are shown in the cutaway above. "A" is movable 7.9 mm. machine gun operated by the bomb aimer who flies facing forward under the pilot's seat. "B" is a 7.9 mm. machine gun occasionally fitted on this ship. Pilot's armor plate giving back and head protection is shown at "C". The upper rear gunner's windshield is shown in open position at "D" with his armor head shield "E" across the 7.9 mm. machine gun. "F". Protection from the rear is given by the armor bulkhead "G". The armor shield "H" is for side protection for the lateral 7.9 mm. machine gun "I". Both forward and rear firing lower gunners operating guns "J" and "K" respectively, are given protection from below and above by the armor plates "L" and "M".

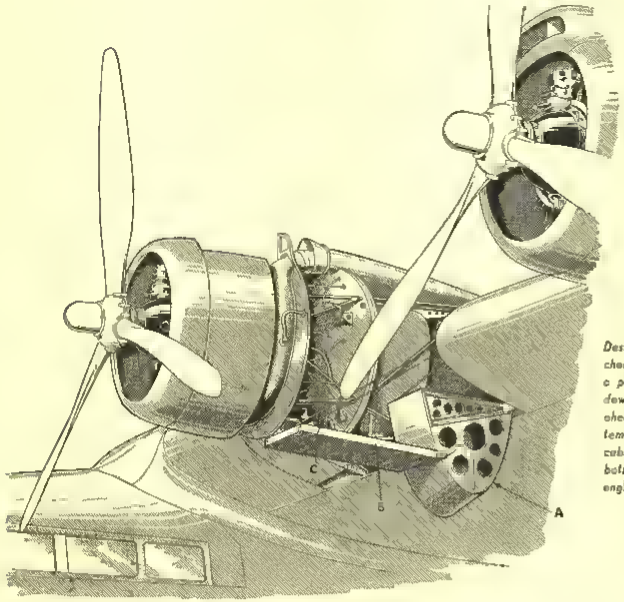
Below is another interesting detail of the He 111 showing the grenade tube "A" which is sometimes fitted into the aft end of the inset edge. This is alternate equipment a remote-controlled machine gun firing straight to the rear often being installed in place of the grenade tube.



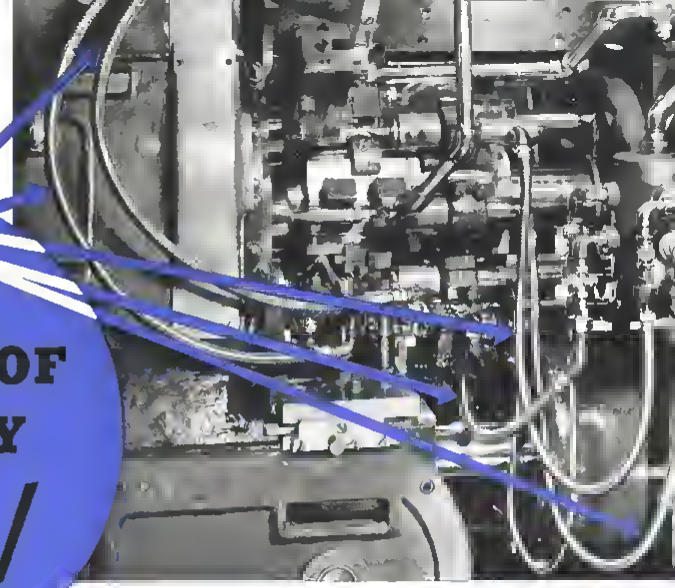


Shown here are side and rear views of the front cockpit by which the Aeronca training plane is converted to the TG 5 three-place training glider. It has been designed so that it is attached to the conventional fuselage at the same points "A" that formerly took the motor mount. The pilot's seat is mounted between the tubes "B" and "C". The tube members come to a point "D" with the control column projecting up through the triangular top truss bounded by the members "C" and "E". The plates "F" are adjustment plates for tension in the rudder cables being attached to the pedals "G". "H" is the tow cable attachment plate.





Designed to provide a work platform for mechanics servicing the Vought-Sikorsky VS-44 A, a portion of the nose wing section "A" swings down from a hinge point near the lower edge ahead of the front spar. To this is attached a temporary platform "B" suspended by light cables "C". Similar facilities are located on both sides of each of the four Pratt & Whitney engines.



These ARTERIES OF INDUSTRY MUST NOT FAIL!

The lifelines of this mechanical era of war and its industrial heart must be of such enduring strength and flexibility that there can be no question of failure.

Metal is the one dependable material possessing the characteristics to withstand all of the stresses of steam and air pressure, the deteriorating effects of oil, liquids and gases, and destructive vibration . . . and still retain the required flexibility.

American Seamless Flexible Metal Tubing, made by corrugating drawn rigid *Seamless* Tube, and American Metal Hose, wound from strip metal, are in the forefront of the battle lines . . . from the depth of sea and earth to the fighting heights of the stratosphere.

This company is still serving most of its regular buyers . . . because they have always been . . . and are now . . . the leading industrialists, whose production is the backbone of both peace and war. Added to these, of course, are the many new plants organized expressly for war production — whose use of American Flexible Metal Hose and Tubing is practically a necessity.

For all connecting and conveying duties, for vibration control, for the correction of misalignment and for protective shielding, there's a type of American Flexible Metal Hose or Tubing — some of which are shown on the reverse of this sheet.



Seamless SS-50 *graphically tells the story of American Seamless Flexible Metal Tubing — gives you important tables and accurate engineering data so necessary under present war conditions.*

Aircraft Bulletin A-48 *provides the essential facts in the form of up-to-the-minute specifications on American Metal Hose Aircraft products — flexible low tension shielded conduit, fittings, flexible aluminum and stainless steel tubing, ferrule attaching machines etc.*

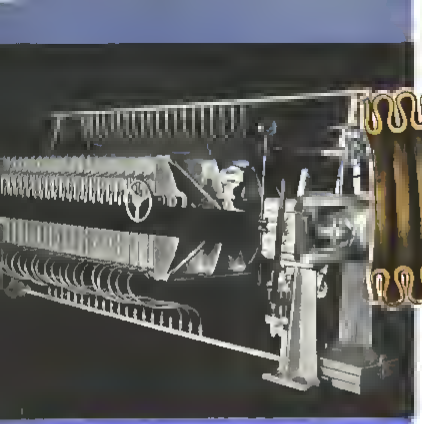
American Metal Hose

ANACONDA

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • • Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Ltd., New Toronto, Ont.



Large Filter Press equipped with American Seamless Flexible Metal Tubing for connections to steam feed and exhaust manifolds.

Note that flexibility is developed in American "Seamless" by corrugating the solid walls of rigid metal tubing after it has been "stretched" to the correct wall thickness. Thus, a continuous flexible metal tubing, with no seams, no laps, no welds, no joints — ideally suited to convey steam, oil, hot water, solvents, gases and some chemicals. Made in various metals. For pressure work, one or more braided wire jackets are added.



Unloading Oil Tank Car with a length of durable American Flexible Steel Oil Hose.

The toughest type of extremely flexible metal hose, especially suited to "heavy duty" all around service in conveying steam and oil. Made by winding strip metal in a "full interlocked" pattern and packing the joints with asbestos. In bronze for steam and water, steel for oil ... also in brass, stainless steel and other workable metals.



American Flexible Metal (low tension) Shielded Conduit is strip wound from aluminum. Used by the aircraft industry for shielding electrical wiring. Made to specifications of both the Army and Navy. Also available is a special flexible metal housing for parachute rip-cords, flexible heat ducts and shielded conduit fittings.

42167

American Metal Hose

ANACONDA

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. Subsidiary of Anaconda Copper Mining Company

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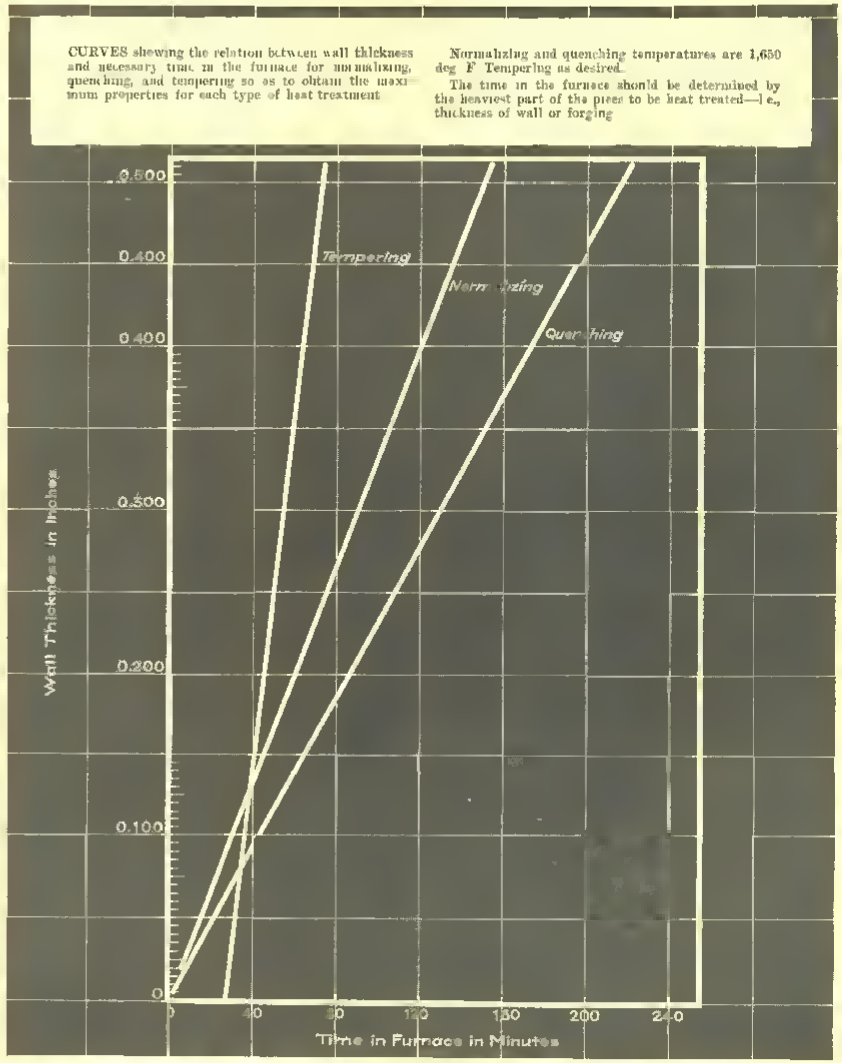
Time Control Chart

S.A.E. X4130, X4135, X4340—TUBING

CURVES showing the relation between wall thickness and necessary time in the furnace for normalizing, quenching, and tempering so as to obtain the maximum properties for each type of heat treatment.

Normalizing and quenching temperatures are 1,650 deg. F. Tempering as desired.

The time in the furnace should be determined by the heaviest part of the piece to be heat treated—i.e., thickness of wall or forging.



Courtesy of Summerill Tubing Company

ELASTIC STOP NUTS

...hold tight in action



Here's a glimpse of the Martin B-26 Medium Bomber at work. As with all the fighting airplanes built in the United States and Canada, this fast hard-hitting ship is protected by Elastic Stop Nuts and Self-locking Fittings at thousands of points where vibration and critical stresses make tight fastenings essential.

» *Catalog on request*

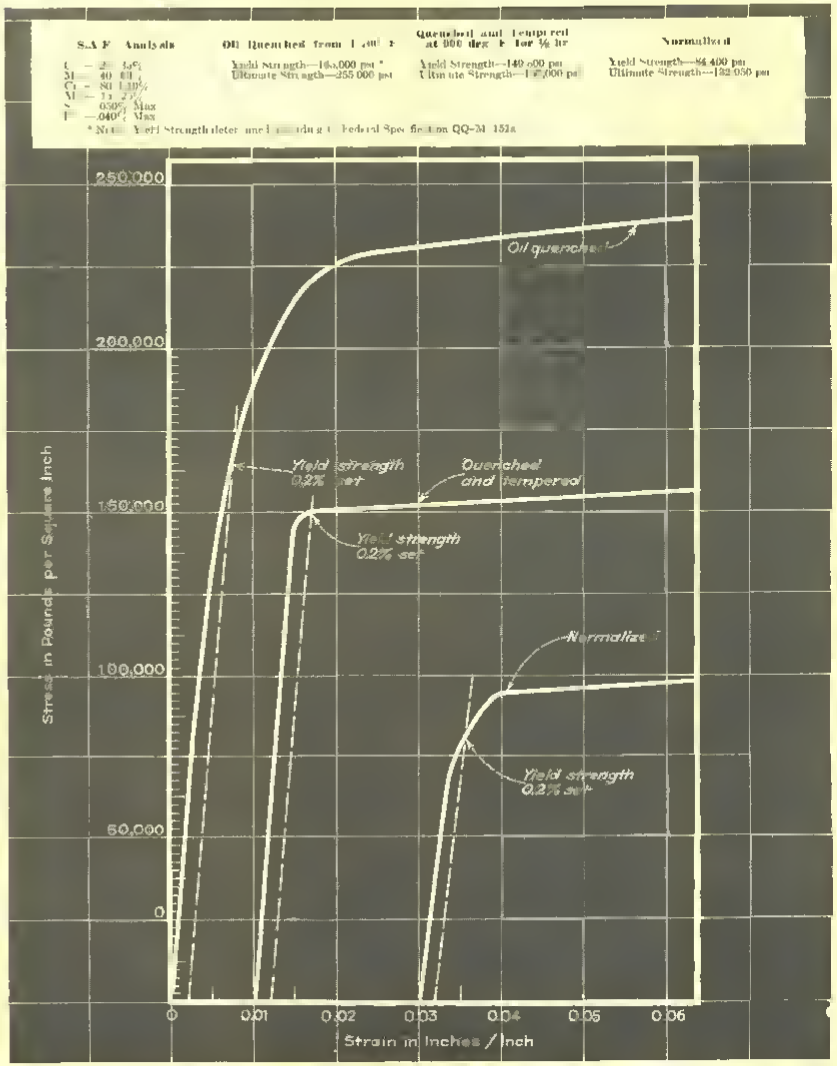
ELASTIC STOP NUT CORPORATION • 2320 VAUXHALL ROAD
UNION NEW JERSEY

Typical Stress-Strain Curves

S A E X4130–TUBING

S.A.E. Analysis	Oil Quenched from [illegible]	Quenched and Tempered at 900 deg. F. for ½ hr	Normalized
C — .25/.30% Mn — .40/.60% Cr — .80/1.10% Mo — .15/.25% S — .050% Max P — .040% Max	Yield Strength—163,000 psi * Ultimate Strength—255,000 psi	Yield Strength—140,000 psi Ultimate Strength—[illegible],000 psi	Yield Strength—86,400 psi Ultimate Strength—132,050 psi

* Note: Yield Strength determined according to Federal Specification QQ-M-151a



Courtesy of Sunnen Tubing Company



Gertie was handy with a gun!

However much her boss might agree with Gertie's sentiments he can't condone her waste of time and good materials. • For in these days of ever-quickening production, personnel must measure up as well as materials... must beat yesterday's bests if we're to win this war! • When it comes to airplane finishing Valspar Val-Aero Aircraft Finishes measure up to all government specifications...beat even today's new high standards of speed and quality. • The best testimony of this fact is that the demand for these famous finishes is jumping ahead by leaps and bounds!

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Information Tips

Keep UP-TO-DATE developments with

This AVIATION Reader's Service is being made available through the cooperation of manufacturers to help executives save that invaluable item—time. It is your service to use—a service which can mean a profit in both time and convenience.

1

For Steel Users—The 84 page pocket sized *Steel Handbook No 42 for Machine Tool Users* is a wartime edition which includes combined standard steel lists of the American Iron & Steel Institute and the SAE for carbon and alloy steel bars with suggested speeds and feeds for machining many of these grades with standard tools on automatic screw machines Also has a 15 page section on cold finishing processes and contains tables giving rpm of spindles at given surface speeds Republic Steel Corp, Cleveland Ohio

2

"Aero-Thread"—Bulletin No 1 describes the Aero Thread screw thread system and gives data on cap screws bolts nuts studs inserts, inserting and extracting tools taps gages and stud drivers Aircraft Screw Products Co Inc 47-23 35th St, Long Island City, N Y

3

Dimensional Control—*Gaging Points* is the title of this new supplement to the first edition of *Dimensional Control* It discusses allocation of gage tolerance with allowance Army Ordnance practice thread gages selection and ordering of gages Written to stimulate thinking toward establishment of a sound gaging policy Published by the Sheffield Corp Dayton, Ohio

4

Machining Aluminum—A new edition of the booklet, *Machining Alcoa Aluminum*, is now available, setting forth general principles of machining aluminum and its alloys It also suggests speeds, feed and depths of cut which will produce satisfactory results, points out where practices and tools common to other metals may be used, and indicates where special practices or tools are desirable Part 1 deals with general shop practice and Part 2 with automatic screw machine operations Published by the Aluminum Company of America Pittsburgh, Pa.

5

Plastics Handbook—A new 70-page *Handbook on Laminated Plastics* covering vulcanized fibre and phenol fibre sheets rods tubes and fabricated parts has just been issued by the Taylor Fibre Co, Norristown, Pa It contains a section on the new laminated plastic reconstruction of aircraft parts such as wing tabs, servo-tabs, wing flaps, radio antenna masts and insulating parts for aircraft electrical and radio service Also included are tables and other data to guide design and production engineers in selection fabrication and application of the correct material for the purpose

6

Lathes—The entire line of South Bend engine, toolroom and turret lathes are described in the company's new catalog English and toolroom lathes range in size from 9 in to 16-in swing; turret lathes are in three sizes having 9, 10 and 13-in swings Specifications are tabulated to facilitate selection and attachments tools and accessories are illustrated and described *Catalog No 100 B*, South Bend Lathe Works Dept X-1, South Bend Ind

7

Forged Fittings—Some 106 kinds of forged steel fittings now available are described in Bulletin A-3, the first section of which gives data on forged steel screwed fittings, the second of which covers the same material for forged steel socket welding fittings and the third of which consists of engineering data for users of fittings Published by Distributing Products Division Watson-Stillman Co, Roselle, N J

8

Woodworking Facilities—*Wood Products Production* is the title of a new eight page bulletin describing plant facilities of a company which for 28 years has specialized in architectural woodwork and custom-built store fixtures now available for contract production of special work and quantity production of standard wood items Issued by Joseph Kaszab, Inc, 1444 W 21st St, Chicago, Ill

9

Black Oxide Finishing—A pocket sized catalog describing the Du-Lite process of black oxide finishing for steel parts, as well as the equipment used to produce it, special metal cleaners and oils developed to secure finished results and services available by the organization The Du-Lite Chemical Corp, 10 River Rd, Middletown, Conn.

10

Marking Devices—An eight page headline describing marking devices for steel stamps, badges and checks brass dies name plates and signs branding devices metal tags and labels, shipping supplies lead seals and sealers, corporate and military seals produced by Dickert Stahler Co 10286 Madison Ave Cleveland, Ohio

11

Molten Salt Baths—Such is the title of a new 72 page illustrated manual dealing with hardening of ferrous metals in baths containing sodium cyanide use of simple cyanide baths as a reheat medium for high carbon and oil hardening alloy steels and for carbonized work and nitriding of high speed steel and other alloy tool steels The Electrochemicals Department, E I du Pont de Nemours & Co Wilmington Del

12

Material Handling Equipment—An eight page bulletin designated No 140 describes and illustrates the full line of hydraulic lift and pallet trucks elevating tables, die handling trucks stacking, turning and hoisting equipment utility trucks and skid platforms special service platform machines and aircraft servicing and production equipment manufactured by Lyon Raymond Corp, 1048 Madison St Greene, N Y

13

Aircraft Products—The new *Penn Aircraft Products Catalog and Handbook* gives, in addition to basic descriptive data for each unit, pictorial reproductions, performance curves, quarter size drawings model classification tables and complete parts lists Loose-leaf construction provides for insertion of additional and revised pages Pump Engineering Service Corp., Cleveland, Ohio

MINUTE on NEW this new free service

New Products

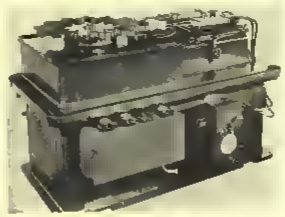
For the informative literature reported on these pages—or for more information on the new products described—simply fill in the Request Form below,* clip it to your letterhead and mail. There is no cost, no obligation.

MODERN MACHINE TOOLS

14

Flame Hardening Machine

Hydraulic Machinery, Inc., 10427 Grand River, Detroit, Mich., announces production of a flame hardening machine with base and external housing structures of welded steel design Electrical control and hydraulic power as a motive source are said to provide wide flexibility of operation. In operation, the part to be hardened is manually loaded on the index table, the pilot positioned with a locating pin, and

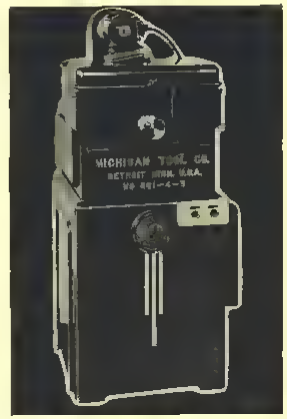


after the start button is pushed, the machine goes through its complete cycle —AVIATION, *October*, 1942

15

Gear Finishing Machine

Michigan Tool Co, Detroit, Mich., announces a new unit, the 861-4B, for rapid finishing to high accuracy of gears of less than 4-in diameter and less than 1-in face width It is said to be particularly suitable for production of gears for instruments, control mechanisms and similar precision devices in which high accuracy, combined with correct tooth form, are essential to successful operation The new machine is automatic with combination hand and electric control, simplifying and speeding gear production It is so designed that several may be installed as a single battery with one operator taking care of more than one machine It is designed to permit finishing a wide variety and sizes of gears with a single cutter for each pitch and pressure angle To adjust the machine for different sized gears, a small handle located on the front of the machine is used The handle is provided with a dial graduated to 0.0005-in travel of the cutter head on its slide. Once it is adjusted for a given size and the proper cutter selected for pitch of the gear, operation becomes entirely automatic. Limit switches and dogs are provided for reversing the machine during its operating cycle The unit is adaptable for finishing gears of stainless steel, carbon steel and non-ferrous materials including brass, bronze, fibre, etc. Cutter



diameter ranges from 2 to 3 in., with maximum face width of ¼ in The minimum center distance between the cutter and the work spindles is 1¾ in with a 4-in maximum center distance The machine is only 20½ in deep, 26½ in wide, and 20 in high, the base being designed to provide a working height of centers above floor of 46 in. The cutter head and work centers are provided with precision unit friction bearings —AVIATION, *October*, 1942

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30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61
62

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Today TENSAL ALUMINUM CASTINGS are going to war!

Tomorrow when the Victory is won...

our foundries will be ready to turn out quality sand and permanent mold aluminum castings with the same precision and speed for your peacetime needs.

And, then, as now, into every casting will go the invaluable experience and skill of our workmen plus the constant research of our technical engineers.

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NEW YORK, 111 Broadway • CHICAGO, 188 W. Randolph • DETROIT, Stephenson Bldg. • LOS ANGELES, 405 S. Hill
MAKERS OF QUALITY SAND AND PERMANENT MOLD ALUMINUM CASTINGS

16

Radial Spot Welder

A radial gun spot welder known as the P I-R in both stationary and buggy mounted units, is being offered by **Sciaky Bros.**, 4935 West 67 St., Chicago, Ill. It is equipped with a special Sciaky welding timer and operates on single-phase AC, 220 or 440 v. Hydraulic pressure is supplied by hydro-pneumatic booster, which can feed a gun capable of supplying maximum electrode pressure of 1,800 lb with 90 psi of air supply. Under steady production conditions the unit is capable of welding corrosion-resisting steel, pickled steel, zinc-coated steel and monel metal in thicknesses of from 0.016 in. plus 0.016 in. up to 0.064 in. plus 0.064 in. The stationary unit reaches a maximum area of 21 ft. in diameter.—AVIATION, *October*, 1942.

17

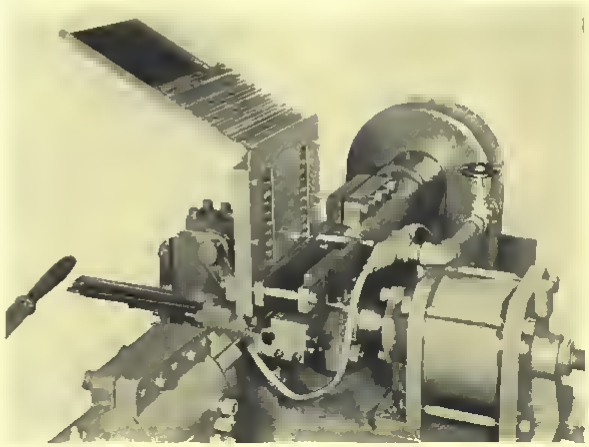
Milling Machine

Sundstrand Machine Tool Co., Rockford, Ill., has begun production of a new double end milling and centering machine suitable for milling to length and centering—in one handling—both ends of shafts ranging from 1½-in. to 6-in. diameter by 14 in. to 72 in. long. A similar machine can be provided to handle shafts from 1 to 4 in. in diameter and from 8 to 48 in. in length. The machine base is a one piece cast iron unit having horizontal ways. Crosswise to the bed ways are mounted two subbases which, in turn, have ways on which cross feeding heads are attached. The left hand sub base is fixed, but the right is adjustable for handling various lengths of stock. Mounted to the bed ways between the two heads are two screw operated self centering vises for holding the work. Electrically operated vises can be provided to simplify loading and unloading of work.—AVIATION, *October*, 1942.

18

Automatic Feed Profiler

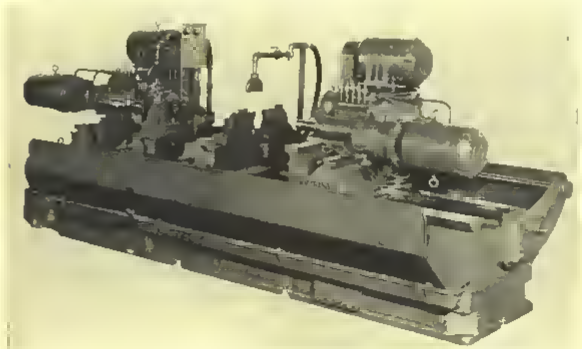
Pines Engineering Co., Inc., Aurora, Ill., is producing an automatic chute feed to the air chuck on its two-spindle profiling machine. The attachment can be used for feeding such items as brass and copper primer tubes for boring and tapping operations on both ends at the same time. According to the manufacturer, production from these machines has been increased as much as 30 percent with the automatic feed. The profilers are being employed for burring, chamfering, facing, threading, centering, reaming and boring both ends of tubes or rods simultaneously.—AVIATION, *October*, 1942.

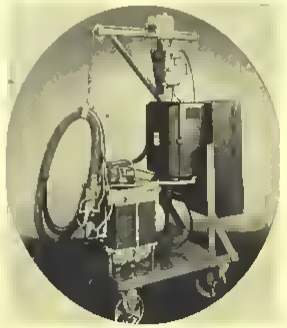


19

Low Pressure Welding Gun

A gun designed for light welding pressure has been introduced by **Progressive Welder Co.**, 3050 E. Outer Drive, Detroit. Gun operating pressure is hydraulic with partially counterbalancing continuous air pressure. The latter also serves to automatically retract the points when hydraulic pres-



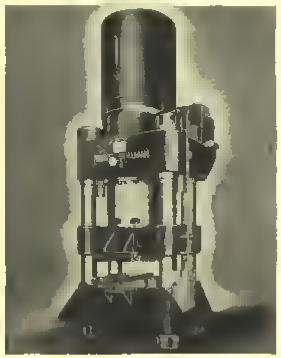


sure is released, thereby simplifying operation. Features of the gun include screw-adjustable stroke (up to 3 in.) to take care of a wide range of work sizes, and quick interchangeable adapters for electrodes to make the gun suitable for a wide variety of work shapes. P-II concentric kickless and highly flexible welding cables and electronic controls are used.—AVIATION, *October*, 1942

20

Forming Press

A 1,800-ton forming press suitable for aircraft propeller and hub work is announced by the **Watson-Stillman Co.**, Roselle, N. J. The press is adaptable to single cycle automatic operation or hand control as required. The unit is entirely self-contained, including 50-hp. motor and radial piston pump delivering 45 gpm. Control is by a single lever, latch operated by a pressure cylinder. The press is vertical four-column type, ram of 35-in. diameter exerts pressure of 2,750 psi with a 22-in. stroke, opening is 37 in. with clear platen area of 42x42 in. Advance and



return speeds are 650 in. per min. with a pressing speed of 10.5 in. per min. The entire unit occupies 6x8 ft. of floor space, has an overall height of 19 ft., and weighs 80,000 lb.—AVIATION, *October*, 1942

21

Vertical Miller

A new vertical milling machine designated No. 1-14V, designed especially for vertical milling operations on small parts, is being introduced by **Kent-Owens**, Toledo, Ohio. The machine has an adjustable hydraulic speed cable with full automatic cycle, and table movements are effected by a control

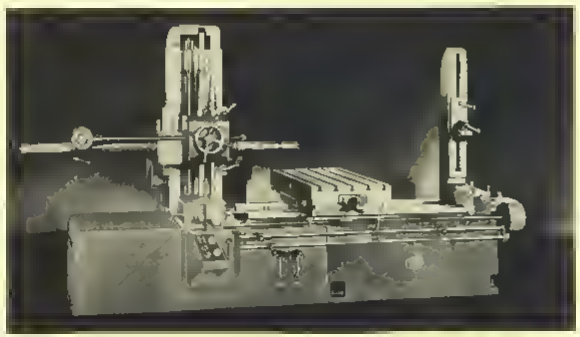


lever which indicates direction of the cable movement. Graduated dials are adjustable to provide any speed rate within a range of from 3 to 40 in. per min. A floor type machine, the motor and hydraulic pump unit for actuating the table are completely closed in the box-type bed. Spindle head has cross adjustment by means of a screw and micrometer dial. Ten spindle speeds ranging from 115 rpm. to 400 rpm. are available. The machine can be equipped with either a one- or two-way positive stop with dwell. With this arrangement, the work is fed into the cutters to a fixed positive stop, where it dwells momentarily while the cut is cleaned before the machine automatically reverses out of the cut.—AVIATION, *October*, 1942

22

Horizontal Boring Mill

Centralized control which motivates an infinite number of speeds and feeds without stopping to shift gears, has



New Products

been incorporated in the new Yoder 3A horizontal boring mill, being produced by the **Yoder Co.**, West 55th St. & Walworth, Cleveland, Ohio. Starting, stopping and reversing of machine and feed are controlled through two bars running along the front of the machine. A two-speed traverse makes it possible to move at a high rate when considerable travel must be made, then inch up to the work at a slow rate. Other features listed by the manufacturer are milling cutters and other attachments may be bolted direct to flange on outer end of spindle; speeds range up to 600 rpm. on spindle and 100 in. per min. on feed for head, saddle and table; heavy multiple thread worm gear on spindle drive eliminates noise and chatter.—AVIATION, *October*, 1942

23

Welder Remote Control

A new remote control unit for arc welding units, now standard on its own equipment, is being offered by **Hobart Brothers Co.**, Troy, Ohio. The new unit is protected from accidental bumping by a metal pullunt handle set over the control dial and by cushion springs on the back of the porcelain rheostat. It puts 100 steps of line volt-amperage adjustment within reach of the operator's hand and can be set up by using an ordinary lamp cord extension to connect it with the machine. The new control is said to speed production even in plants where machines are close to the work, especially in elimination of weld craters.—AVIATION, *October*, 1942

WITTEK *Aviation* HOSE CLAMPS



Curtiss P-40F Warhawks Equipped with Wittek Aviation Hose Clamps

..MEETING AVIATION'S WARTIME NEEDS

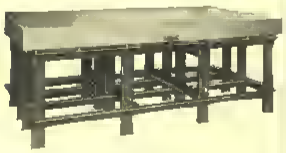
..FOR DEPENDABLE HOSE CONNECTIONS..



Wittek Type FBA Aviation Hose Clamps are made of quality materials and designed to meet existing active Army and Navy specifications. Known as the standard of the industry for dependable hose connections since the beginning of modern aviation, Wittek Aviation Hose Clamps are being used today by the outstanding manufacturers of Army and Navy aircraft.

WITTEK *manufacturing co.* 4305-15 WEST 24th PLACE ★ CHICAGO ILLINOIS

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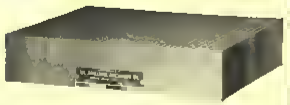


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● Highly recommended for use where a true, rigid, smooth surface is required for layout, inspection, or assembly. Planer finish—dependable and accurate. Sold with or without reinforced, all-steel frame—arc-welded to give it the strength and solidity of one-piece construction. Frame is provided with lock leveling screws which enable user to level the plate quickly and lock it securely. Plates are made in 8 standard sizes, all six inches thick. Write for full details.

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... and CHALLENGE LAPPING PLATES



Specifically designed to assure a perfect fit when lapping metal-to-metal joints on which no sealer is used. Made of semi-steel, specially heat-treated and carefully machined. Grooves are 1/16-inch 1/2 inch apart, running full length and width of the surface. Plates are available with or without all-steel, arc-welded stand.



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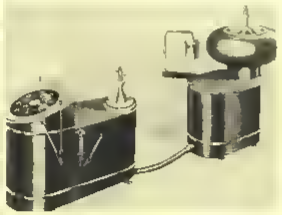
THE CHALLENGE MACHINERY CO.
GRAND HAVEN, MICHIGAN

SHOP EQUIPMENT & ACCESSORIES

24

Wheel Balancer

Both static and dynamic balancing of aircraft tires, tubes and wheels are said to be possible through use of the new Manbee Aero Wheel Balancer, introduced by the **Manbee Equipment Co., Inc.**, 406 South Kolmar Ave., Chicago, Ill. The balancer is a duplex unit,



equipped with two wheel mounting heads and static rails, the smaller head assembly for balancing tires up to and including 26-in. diameter, and the larger head for tires up to 65-in. diameter. The control board indicating lights show the exact point where tire or tube is out of balance and the hydraulic pressure gage indicates the exact amount of weight required to bring the unit into balance. The pressure gage can be read in 1/4-oz. denominations. The unit is powered with variable speed motors which drive the wheel assembly at any speed desired from 40 to 120 mph. Static and dynamic balance can be taken in from 3 to 12 min., according to the manufacturer, making it possible to check more than 40 units per 8-hr. day.—AVIATION, *October*, 1942

25

Angle Speed Nuts

Designed for fastening junction box covers, switch box covers, and other angular attachments or right angle blind attachments are the new angle Anchor Speed Nuts No.—5080—manu-



factured by **Tinnerman Products, Inc.**, 200 Fulton Road, Cleveland, Ohio. The fastening consists of a self-retaining "U" spead nut snapped over the short leg of the right angle bracket and is interchangeable with other angle Anchor lock nuts. It is available in 86-deg., 90-deg. and 94-deg. angles for 6/32 and 8/32 machine screws, and 4Z, 6Z and 8Z sheet metal screws.—AVIATION, *October*, 1942

New Products

26

Tail Light Flasher

Introduction of a tail light flasher unit, to meet CAA regulations soon to go into effect, is announced by **Bendix Aviation Ltd.**, North Hollywood, Calif. It will be known as Bendix Flasher, Model 4900. It produces 40 alternating



white and red flashes per minute and is equipped with a safety device which automatically lights the white light continuously should any mechanical or electrical failure occur. Accuracy of flashing is obtained by the use of a constant-speed, compound-wound, ball bearing motor which is mounted directly to the reduction gear housing. Use of tungsten points in the switch which are conservatively rated to handle six amperes assure long life. All circuits in the flasher are filtered against radio interference. Measuring 4 1/2x3 3/8x6 in. overall and weighing 2.1 lb., the flasher is housed in a dust and moisture proof case and can be removed for inspection by loosening two wing bolts and disconnecting a single AN type plug. It draws six watts and can be supplied for either 12 or 24 volt systems.—AVIATION, *October*, 1942

27

Aligning Shaft Coupling

A new coupling for driving and driven shafts which permits misalignment up to 3 deg. on each shaft has been developed by **Barnes Engineering Co.**, 3931 Falls Rd., Baltimore, Md.



The unit comprises a cylindrical housing shell cut with internal gears having stub teeth with 20-deg. pressure angle. The shafts are connected to hubs of generated gears, each full on a true central segment of a sphere, the surface of teeth being of constant width throughout their length. The teeth of each spherical gear meshing in the stub teeth of the housing produce a smooth ball action, contributing to reduction of friction and pressure on shaft bearings if the shafts are out of alignment. The specially designed spherical gear is in full mesh on pitch line with internal gear at all times and with maximum reduction of backlash. An outstanding aircraft application is reported to be in connecting gear box to pump in generator, in which case one-half coupling is placed at each end of the shaft.—AVIATION, *October*, 1942

28

Weather Seal

A new all weather, all purpose door seal consisting of a seamless tube of high grade sponge rubber into which is molded a tightly woven fabric containing spring wire with a special extruded rubber jacket is being produced by **Bridgeport Fabrics, Inc.**, Bridgeport,



Conn. It is said to conform readily to intricate shapes with the wire spring making a tight fit. Right angle bends can be made through a simple incision in the fabric. Sizes range from 1/8 in. diameter for the circular seal with 1/4 in. flange to 1/2 in. diameter, also with 1/4 in. flange.—AVIATION, *October*, 1942

WHEN SHORTAGES BRING YOU TO A DEAD END...



Let New Celotex Building Products Help You Find a Practical Way Around!

THE VICTORY program must not be halted. Countless military and industrial construction projects are being rushed to completion. But, just at the crucial moment, delay is often threatened by a shortage of some critical material. An A-1-a Priority doesn't do any good if there is none of that material to be had!

If your project has a high priority rating, there is often a practical way around such "dead ends"—by using Celotex Building Products, many of which have been specially developed to replace critical materials. Insulating exterior walls—partitions—shock-absorbing floors—built-up roofs and roof insulation—sound conditioning for office and factory—these are a few of the needs Celotex Products can help you meet *immediately!*

Countless vital victory projects are moving ahead, *around the "dead end"* because of the availability of dependable products provided by many Celotex plants working at full capacity. Write for your copy of our new Industrial Catalog No. 9—and see how many of *your* urgent demands are met by Celotex Products!

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THE CELOTEX CORPORATION • CHICAGO

ELECTRUNITE TUBING *is Proved by the Most Modern* Method of Testing

Regardless of the reliability of the process employed and the skill of those who operate the manufacturing equipment, defects—although invisible to the eye and imperceptible under ordinary testing methods—may at some time be found in all types of aircraft tubing.

To detect these injurious defects, Steel and Tubes engineers, culminating 13 years of research, have developed FARROTEST—the most modern method of *non-destructive, electric testing*—a method capable of pointing out minute imperfections undetectable by other methods.

Today, every length of Republic ELECTRUNITE Aircraft Tubing must pass this test and thus prove its complete soundness before shipment.

In addition, ELECTRUNITE Aircraft Tubing provides other advantages. It is consistently uniform in diameter, wall thickness, concentricity, strength, weight, ductility, hardness, weldability and scale-free surface. It meets specification standards of the U. S. Army Air Corps; Bureau of Aeronautics, U. S. Navy, and the Civil Aeronautics Administration.

ELECTRUNITE Aircraft Tubing is made of S.A.E. X-4130 steel in sizes from ⅜" O.D. to 1⅝" O.D.—.028" to .065" wall; of S.A.E. 1025 steel in sizes from ⅜" O.D. to 5" O.D.—.028" to .148" wall; and of Enduro* Stainless Steel in standard analyses in sizes from ⅛" O.D. to 3" O.D.—.028" to .120" wall.

Write for further information.



Official Photograph—U. S. Army Air Corps

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REPUBLIC STEEL CORPORATION
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Union Drawn Steel Division • Culvert Division • Truscon Steel Company
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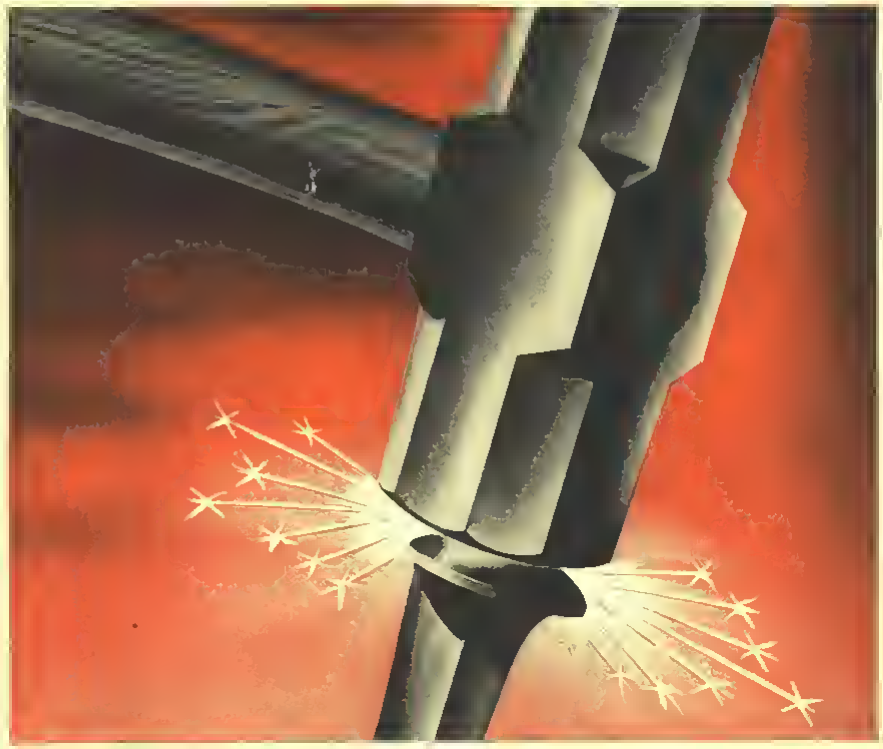
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Also Boiler Tubes • • • Condenser and Heat Exchanger Tubes



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EVER see carbon dioxide gas in its working clothes?

You've seen it in other ways Carbon dioxide is the bubbles in champagne, it is the fluffiness in biscuits, it's the "head" on a glass of beer Yet we know carbon dioxide as one of the deadliest of fire-killers. We use it that way in Kidde Extinguishers

There's another thing about carbon dioxide—it is the *most compressible* of the industrially available gases Under 850 lbs pressure at 70° F. carbon dioxide is a liquid When released, it becomes a gas, *expands 450 times its former stored volume!*

Harness this terrific expansion and you have a source of quickly available power, produced by the turn of a valve There are 30,000 foot pounds of energy in a single pound of carbon dioxide. Compressed nitrogen, for example, delivers only one-third as much energy

Engineers of Walter Kidde & Company have designed valves which release this energy in an instantaneous burst, or which apply the power over a prolonged period, a bit at a time We can supply "peanut-size" cartridges or big 100-lb.-capacity cylinders to hold the carbon dioxide charge.

If you have a problem involving power actuation, consider carbon dioxide Its high factor of available energy gives this gas a tremendous significance to the aeronautical engineer. The Research and Development Department of Walter Kidde & Company has evolved interesting applications of power actuation using carbon dioxide under high pressure. Please consult us, if we can assist you.

Kidde

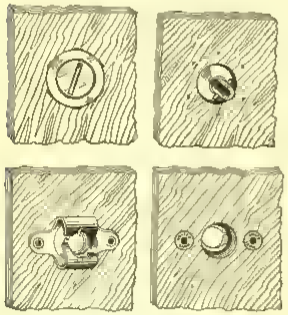
Walter Kidde & Company, Inc.

1022 WEST ST., BLOOMFIELD, NEW JERSEY

29

Cowl Fasteners for Plywood

United-Carr Fastener Corp., 41 Ames St., Cambridge, Mass., has just developed a line of its Air Line cowling fasteners suitable for use with plywood. But one hole in the plywood is required for the stud, and adequate pressure on attaching tools is said to



set the washer nearly flush with the outer surface of work. The spring lock mounting requires the same center hole as the stud, but two holes for the rivets. Eyelet flanges or washers can be pressed into the wood to secure flush mounting on that side. The fasteners can be mounted by means of a pronged steel washer which increases the bearing strength of plywood, as well as facilitating installation.—AVIATION, *October*, 1942.

30

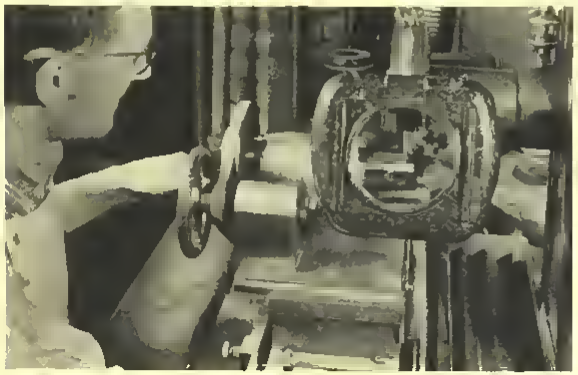
Inspection Lenses

Four new models of "Super Sight" inspection lenses which are also adaptable to small parts assembly and precision machining have been introduced by the **Boyer-Campbell Co.**, 6540 Antoine St., Detroit, Mich. The 95ZC model has two magnifying lenses—the top 5 in. and the lower 4 in. in diameter—lighted separately. The lower lens is adjustable or either lens can be used alone as necessary. For bench work and small parts assembly the 44ZC has a 4 in. magnifying lens and the 89ZC has a 5 in. lens. Both are attached to a swinging bracket to enable use over a wide bench area. For precision machining the 89U type, which has a 5 in. magnifying lens, is fitted with safety lens to protect the magnifying lens. This type is also equipped with universal brackets.—AVIATION, *October*, 1942.

31

Plastic Cleaner

The **Commercial Chemical Co.**, Charlestown, Mass., has recently developed a new process for cleaning and general protective maintenance of all types of transparent plastics. This new product is being sold under the trade name of Plasticlean which is made up of a Plasticlear Cleaner and a Plasticlear super-hard Wax. To use the cleaner product is applied with a cloth, allowed to dry and simply wiped off. The wax sealer is applied with a wet cloth, and immediately rubbed with a dry cloth without allowing the wet wax to dry before the application of the dry cloth. The new principle of this cleaner is that it has been compounded as a partial dirt absorbent which permits dirt and grit to be safely removed without scratching the plastic while being wiped off. Superhard wax is likewise a new departure. The product is polarized to penetrate any microscopic pores in the plastic surface and set up a superhard, thin glaze or film of such hardness and high melting point that there is no tackiness even when waxed plastic is left exposed to the direct rays of the sun.—AVIATION, *October*, 1942.

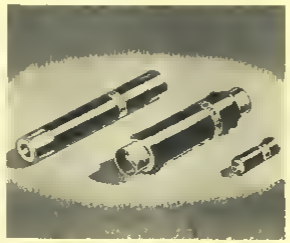


New Products

32

Ferrule Resistors

A new ferrule resistor designed for easy interchangeability without the use of tools has been announced by the **Ohmite Mfg. Co.**, 4835 Flournoy St., Dept. 11L, Chicago, Ill. Ferrules are tin sleeve or cartridge type, the wire terminated on metal bands or ferrules which permit mounting in fuse clips. Special ceramic cores are available which, with special coating, will with-



stand the temperature shock test of repeated immersions alternately from ice water to hot water. Protective coatings which pass salt water immersion tests are also available.—AVIATION, *October*, 1942.

33

Aviation Universal Joint

Specially designed for greater maneuverability with rigid, tight, yet sensitive and quick, easy action demanded for aircraft operations, the new Dix aviation type universal joints manufactured by the **Dix Manufacturing Co.**, 603 E. 55th St., Los Angeles, Calif., are said to operate at a greater angle than other similar joints. The line of joints of special high quality alloy steel are heated and precision-machined to Air Forces, Army and Navy specifications. Hub joints are guaranteed for aircraft requirements and sizes range from ¼ to 4 in. hub diameter ready for installation, while special types and sizes can be designed to meet any desired requirements.—AVIATION, *October*, 1942.



Breeze Flexible Conduit Girdles The Globe!



BREEZE Flexible Shielded Conduit is in active service today on world-wide battle fronts. Developed and perfected by Breeze, this conduit not only shields aircraft radio and ignition systems, but also affords flexible protection to electrical wiring. Breeze is now producing this, as well as many other items of war equipment, in ever-increasing quantities for the fighting forces of the United Nations.

BREEZE MARK

BREEZE CORPORATIONS, INC. · NEWARK, NEW JERSEY

34

Small Aircraft Motor

A new small fractional-horsepower frame motor designed for aircraft control and protective devices, has been added to the line of the **General Electric Co**, Schenectady, N. Y. Designated



the BA-10, the motor weighs but 8 oz., is 3⅞ in. long by 1⅜ in. in diameter and includes a gear reduction to a speed of approximately 125 rpm.—AVIATION, *October*, 1942

35

Plug Valves

Homestead Valve Manufacturing Co., Coraopolis, Pa., announces a new line of "Lever-Scald" Plug Valves for 150 lb. working pressure. Face to face dimensions of each valve in the new line are the same as those of the corresponding size of wedge-gate valve. Thus they are instantly interchangeable with wedge gate valves, without necessitating piping changes. The company's "quarter turn" operation and a powerful leverage to provide positive opening or shut off under all conditions are features of the new line. Sizes range from 1½ to 10 in. in either semi-steel or steel.—AVIATION, *October*, 1942

36

Vibration Tester

A new power "tuning fork" vibration testing machine developed especially for testing lightweight equipment, such as relays, has been developed by the **Kurman Electric Co., Inc.**, 241 Lafayette St., New York, N. Y. Utilization of the tuning fork principle is said to limit the vibration to the machine itself to such an extent that vibrations are not transmitted to the table or floor, making it possible to operate two or three such machines in the same room at one time. An unusual feature rests in the ability to conduct vibration tests in any plane and instantly change the angle while the test is under observation, as well as to conduct simultaneous tests under different conditions. Amplitude and frequency are variable in tests. The machine requires 75 watts for maximum test conditions.—AVIATION, *October*, 1942

37

Adjustable Floodlights

Commercial Metal Products Co., 2255 W. St. Paul Ave., Chicago, Ill., announce three sizes of Compco Floodlights for three-way adjustable lighting. Ready for installation, the new lights are provided with heat resisting lenses insulated to prevent smoke, dust or rain from penetrating. Made of one piece formed steel, the lights have a baked on "plastic enamel" surface both inside and out.—AVIATION, *October*, 1942.

38

Angle Drill

Designed to get into places that cannot be reached by conventional tools is a new Aerocraft Junior Angle Drill



just announced by **Aircraft Tools, Inc.**, of Los Angeles, Calif. Available only in a 90 deg. model, the "Junior" is 5¼-in. long. Its nose spindle has 10-32 thread. It will operate at high speed and is said to remain cool even after prolonged use.—AVIATION, *October*, 1942

New Products

39

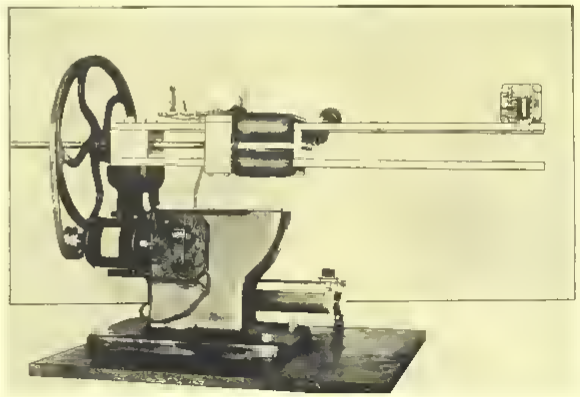
Portable Bending Machines

A new portable hydraulic bending machine has been developed by **Tal's Prestal Bender Inc.**, Milwaukee, Wis. It is said to be capable of bending without heating or filling all iron and steel pipe, as well as solid bars of mild steel, from ⅜ to 2 in. diameter in three minutes or less. Total weight including seven different sized formers, ranging from ⅜- to 2-in. sizes, extension piston and platter, is 158 lb. All parts are completely housed in a permanent wooden box measuring 10x12x20 in.—AVIATION, *October*, 1942

40

Arc Welding Electrode

A new arc welding electrode designed to build more speed to arc welding is announced by **Lincoln Electric Co.**, Cleveland, Ohio. Designated the Fleetweld 11, it has been created to use with the "Fleet-fillet" welding technique. It is a shielded arc type and heavily coated to exclude oxides and nitrides from the weld, and is said to be a fast flowing electrode which gives a deeper penetration of metal into the root of the joint.—AVIATION, *October*, 1942





You can trim wing sections, windshield frames—*any stamping*

any size—any shape

on a QUICKWORK-WHITING Rotary Shear

Save valuable press time—save time of tooling trimming dies. This Quickwork-Whiting Rotary Shear finish trims any deep-drawn or irregular shaped stamping of any size. Operating speeds up to 33 feet per minute are easily maintained. The shear has two speeds and foot control leaves hands free to guide work.

Quickwork-Whiting Rotary Shears are also used for straight or irregular cutting, beveling, joggling, and other operations. They are used for job shop work or line production.

Save time with a Quickwork Rotary Shear. Write for information.

Quickwork-Whiting Division, Whiting Corp., 15623 Lathrop Ave., Harvey, Ill.



For trimming stampings in a single plane, use the Quickwork Whiting Stamping Trimmer—fast, accurate, and economical.

STAMPING TRIMMERS
ROTARY SHEARS
POWER HAMMERS

QUICKWORK-WHITING DIVISION
WHITING
CORPORATION

41

Polishing Brush

A polishing brush using tampico fibre of thistle plant and designed to increase safety of military aircraft by eliminating peculiar "stress concentration points" has been developed by the **Osborn Manufacturing Co.**, 5401 Hamilton Ave., Cleveland, Ohio. "A connecting rod that would have required a day to polish by ordinary means a year ago can today be polished in half an hour with the assistance of a tampico brush," the company states.—AVIATION, *October*, 1942



42

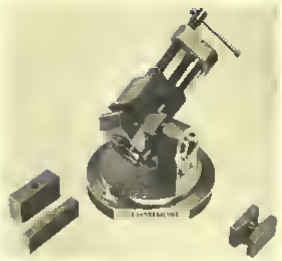
Torque Wrench

Apco Mossberg Co., 122 Horton St., Attleboro, Mass., has developed a new torque wrench in four dial sizes: a unit measuring 0-150 in.-lb. of tension on an outside scale, first revolution—up to 250 in.-lb. on an inside scale, second revolution, calibration range 0-600 in.-lb., a range of 0-1,200 in.-lb.; and range of 0-2,400 in.-lb. With the four sizes of dials and calibration range of each limited, dial graduations are larger and more widely spaced to make readings quicker and more accurate. Mounting of the dial has been improved over other models, it is said, being set inside an extension of the handle where it is more rigid and better protected from shocks. Operating accuracy of 98 percent is guaranteed.—AVIATION, *October*, 1942

43

Angle Package

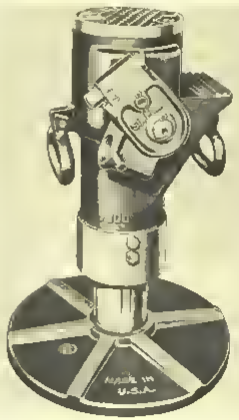
A new "angle machining package" designed to reduce set-up time for production of compound angles is announced by the **F & H Mfg. Co.**, 6024 Ellery St., Detroit, Mich. It consists of three parts: the F & H Universal vise with improved locking control, a grinding wheel angle dressing attachment and a swivel clamp for holding odd shaped work pieces. The vice is precision built, all-steel with hardened and ground jaws and measures 4¾ in. in height while permitting jaws to open to standard width of 2¼ in. The grinding wheel dressing attachment is said to eliminate the need for a separate angle wheel dresser.—AVIATION, *October*, 1942



44

Speed Screw Jack

Designed for heavy duty lifting, lowering and skidding work is the new 25 ton standard speed, bevel gear, ball bearing screw jack presented by **Templeton, Kenly and Co.**, Chicago, Ill. Toe lift is a minimum of 11 in. from base, but jacks can be made with toe in any position to suit user's requirements. The No. 7300 model illustrated is guaranteed to lift its full rated capacity of 25 tons on cap and 12½ tons on toe. It has a full 6 in. lift and weighs but 82 lb. complete.—AVIATION, *October*, 1942



New Products

45

Skin Holder

A new safety skin holder for which several advantages are claimed is being produced by **Prestole Devices**, Toledo, Ohio, under the name Prestole. New design is said to hold skins firmly together and at the same time completely fill up the rivet hole, thus insuring perfect alignment. Cold forged thrust pin and holding member with integral head is so assembled that it is said the unit will not fly apart to endanger workers. It is interchangeable with all popular fastener tools now in use. Currently made in the regular and many special sizes.—AVIATION, *October*, 1942

46

Line Connections

A new line of straight and 90 deg. angle swivels for use in making oil, grease, air and other line connections between stationary and revolving, oscillating or other moving surfaces, has been introduced by the **Trabon Engineering Corp.**, Cleveland, Ohio. Two types of construction are offered, the standard ball bearing swivels which are available in ⅛, ¼, ⅜, ½, ¾ and 1 in. pipe sizes, and the light duty swivels without ball bearings which are intended for use only in lighter work when space limitations do not permit use of the standard ball bearings. Light duty swivels are offered in ⅛ and ¼ in. pipe sizes. Both standard and light duty swivels are furnished with right hand threads in both head and stem, but left hand threads can be furnished on special order.—AVIATION, *October*, 1942



47

Ignition Booster Coils

Two newly designed ignition booster coils for aircraft engines have been introduced by **General Electric Co.**, Schenectady, N. Y. One coil is for use

CRESCENT

is an important source of supply for

AVIATION CABLE

Crescent manufactures a complete line of electric wire and cable for every aircraft need—starter cable, high-tension cable, primary cable—original or replacement. Crescent also manufactures welding cable.

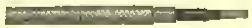
And every Crescent Aviation Cable is a quality cable—made of prime materials, processed under the Dostam Method of manufacture for high efficiency, long life, dependability and uniformity.

We will promptly answer your inquiries concerning wire or cable for any type of service.

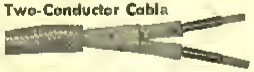
THE CRESCENT COMPANY
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Largest independent maker of replacement wiring for the automotive industry

Lighting Cable



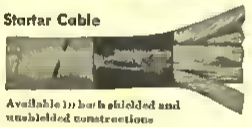
Two-Conductor Cable



Ignition Cable



Starter Cable



Available in both shielded and unshielded constructions

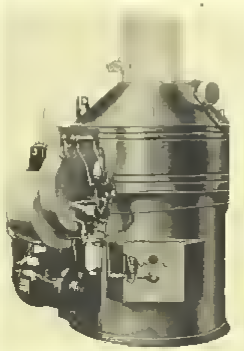
P.S.
OF COURSE, CRESCENT WIRE AND CABLE FOR THE AIRCRAFT INDUSTRY MEETS ALL ARMY AND NAVY SPECIFICATIONS . . .
Wire Joe

on 12-v circuits, the other on 24-v, both are designed to comply with Air Forces specifications. Housing of the booster coil is constructed of a specially designed material said to provide extra insulating strength and high resistance to arc-over. The coil is reported to operate successfully over a wide range of temperatures—from minus 70 deg. F to plus 200 deg. F.—AVIATION, *October*, 1942

48

"Packaged" Steam

A new "recirculated" type steam generating unit has been developed by **Vapor Car Heating Co., Inc.**, 80 E. Jackson Blvd., Chicago, Ill., which produces steam from a cold start to pressures up to 300 lb. in less than two



minutes. Available in standard "packages" of 500, 1,000, 1,500, 2,000, and 3,000 lb. evaporation per hour, the new unit is said to require no boiler room or high draft stack, and can be made completely or semi-automatic according to specified requirements. A single motor drives all necessary units with water blower and fuel feed controlled by steam demand. Interlocked automatic regulation assures safety, the company reports.—AVIATION, *October*, 1942

49

New Alloy Sprayer

A low cost, self-contained, portable metal atomizer capable of spraying any neutral alloy which has a melting temperature up to 600 deg. F. for protective coating, reproducing likenesses, etc., has been developed by **Alloy-Sprayer Co.**, 2040 Book Building, Detroit, Mich., for use in making templates, spotting or checking dies, and reproducing molds. The new sprayer requires only a connection with electric

New Products

power and factory air pressure lines for operation, and it is said no special training is required on the part of the operator.—AVIATION, *October*, 1942

50

Visual Checking Gage

A new thread roll snap gage designed for production inspection has been developed by **Verd, Inc.**, Pasadena, Calif. Fitted with eccentric pins for adjustment to precision size, to compensate for wear and allow variable tolerances, this inspection tool is made from special tool steels. The new model has a strengthened frame and convenient machine pads for bench set-ups. It is available to holders of high preference ratings in a full range of sizes and tolerances from 0 to several thousandths.—AVIATION, *October*, 1942

51

Air Line Filter

Two and three outlet CCA filters for cleaning compressed air lines for serving two or three air tools operating from one point, are announced by **Filters, Inc.**, 3729½ San Fernando Rd., Glendale, Calif., and the Burklyn Corp., 3429 Glendale Ave., Los Angeles, collaborators in the development of the



new unit. Hansen couplers, with which they are equipped, are distributed by the latter firm. Centrifugal action of the air within the filter removes 90 percent of the dirt and moisture and the balance is filtered out by a special wool felt glove. For cleaning the new two and three-outlet models, the water and dirt are blown out of the drain valve at the bottom of the bowl and the filter may be completely dismantled without disconnection from the air line.—AVIATION, *October*, 1942

52

Hand Marker

A new hand marker for branding packing and plastic materials, packing cases, wet belts, tires and other mate-



rial, has been developed by the **Acromark Corp.**, 9-13 Morrall St., Elizabeth, N. J. The tool incorporates an ample size heat unit protected by a metal guard. The heating element extends into the die holder to throw the most heat to the marking head for good branding results. Type and dies are made of brass or bronze alloy for some branding purposes and for others, steel is used. Special branding heads can be made for design or name branding only. The unit is made in several sizes to suit various marking requirements and a smaller model can be used for branding crystal holders and other parts used by Signal Corps and Communication Systems.—AVIATION, *October*, 1942

53

Plastic Line Support Blocks

Introduction of a "Victory Series" of plastic supports using only one-eighth of the critical synthetic rubber material necessary for previous standard Adel 800 A line supports is announced by **Adel Precision Products Corp.**, 530 W. 6th St., Burbank, Calif. Through new processing and tooling techniques it will be possible to make the new supports in the 2,000 types and sizes currently available from the standard "Adelite" material, the company reports. In addition, sufficient equipment will be available for completely new designs. Strict interchangeability has been maintained with previous support so that aircraft detail and assembly installation drawings will therefore require no changes.—AVIATION, *October*, 1942.





DARNELL

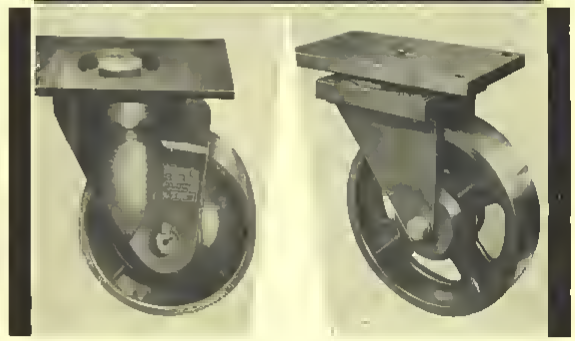
CASTERS & WHEELS

For light, medium or heavy duty service Darnell Casters and Wheels are dependable—saving floors, equipment, money, time and temper.

FREE Manual FOR THE Asking

DARNELL CORP. LTD., 60 WALKER ST., NEW YORK, N.Y.
LONG BEACH, CALIFORNIA, 36 N. CLINTON, CHICAGO, ILL.

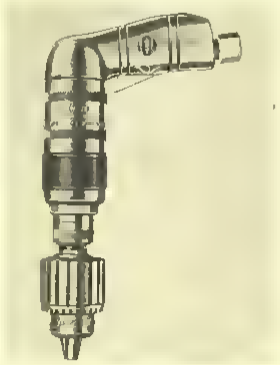
A SAVING AT EVERY TURN



54

Small Pneumatic Drill

Addition of new ¾ in. capacity air drills, straight and right angle, to the line of rotary pneumatic tools, is reported by the **Aro Equipment Corp.**, Bryan, Ohio. The new drills, available



at prices only slightly higher than the company's ½ in. drills, are reported suitable for a wide range of jobs in aircraft plants.—AVIATION, *October*, 1942.

55

Adjustable Service Light

A new portable fluorescent service light, adjustable from 30 in. to 7 ft. in height, and designed to project light into many inaccessible places, at any angle of 180 deg. arc, has been developed by the **Lumidor Manufacturing Co.**, Los Angeles, Calif. It has been used indoors to project light under



wings and fuselages of airplanes in an area normally in shadow from overhead lighting. When used outdoors the light is easily portable by tipping and rolling on casters. It is mounted on a cast iron base, and other features include power factor correction for the two 48-in. 40 w. fluorescent lamps, a high-backed enamel reflector, and, if desired, a screen to protect the lens at extra cost.—AVIATION, *October*, 1942.

56

Hand Pump

Less weight and reduced machining are claimed for the pressure molding process by which the **Harvill Aircraft Die Casting Corp.**, 6251 West Century Blvd., Los Angeles, Calif., produces the pump body and fulcrum of hydraulic system hand pumps now being manufactured by the company's new hydraulic division. Known as model 66-2000 series, the pumps conform to SAE aeronautical standards and are interchangeable with other pumps built to the same standards. Three models are in current production, all with 1½ in. cubic displacement. Including the han-



dle and fulcrum assembly, there are only 13 different parts in the Harvill pump. They have passed cold and life tests and are approved for certain Army Air Forces and United States Navy aircraft.—AVIATION, *October*, 1942.

57

Cooling Tower

A new atmospheric cooling unit approximately 12 ft. square and 14 ft. high capable of cooling a diesel engine of approximately 2,000 hp.—both for water and lubricating oil cooling—has been developed by **Young Radiator Co.**, Racine, Wis. Called the "Quad," the unit is a four-sided assembly, the sides of which are comprised of heat transfer surfaces for oil, water, or gas cooling and for steam or vapor condensing, as required. It contains a high capacity specially designed induced draft fan mounted horizontally at the top of the tower, drawing air through the heat transfer elements and discharging it upward through an aerodynamically designed discharge stack. The component side members are individually assembled for ease of handling so that

New Products

the entire unit may be erected at point of operation.—AVIATION, *October*, 1942.

58

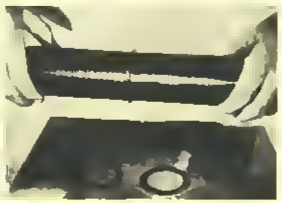
Extension Ladder

A steel tubular extension ladder has been developed by **Vulcan Manufacturing Co., Inc.**, St. Paul, Minn., for use by maintenance engineers, service men and mechanics working with today's large aircraft. Adjustable to any position or height to do the necessary work in construction or servicing of aircraft, the ladder is equipped with large ball-bearing swivel rollers to facilitate moving. The casters are equipped with 4-in. composition wheels, ball-bearing swivels and side arm brakes. A complete set comprises two ladders and catwalk with guard rail which can be mounted between them, but the ladders may be used separately.—AVIATION, *October*, 1942.

59

Plastic Pipe

Dow Chemical Co., Detroit, Mich., announces a new resin plastic known as Saran, for making pipe in the same dimensions as steel pipe of 2 in. OD, or



less. The pipe is said to be entirely unaffected by water, and only a few solvents exhibit any adverse effects. Heat resistance is said to be excellent up to 175 deg. F., and the pipe can be readily welded, heated and bent. It can be cut with a wood saw or hacksaw, and threaded with ordinary iron pipe dies. Fittings for the pipe, except standard flanges, are currently not available, but are expected to be in production shortly. Molds are now being constructed to make additional flanges, with threaded ells, tees and couplings to be available in the near future.—AVIATION, *October*, 1942.



Careful segregation and identification of alloy iron and steel scrap should be standard procedure in every plant collection program.

1. It helps conserve essential, scarce alloying elements.
2. It helps eliminate wasted time, material and effort in the steel mills.

Alloying elements such as cobalt, molybdenum, nickel and tungsten are readily recoverable from scrap. If their presence in a lot is known, the scrap can be used in making up a charge of alloy steel of the same or similar analysis. The amount of alloying elements that must be taken from stock is reduced.

But, if, through lack of segregation, alloy scrap gets into a charge where no alloys are wanted, such as a plain carbon steel, the alloying elements are utterly wasted. It is also possible that the heat itself will be lost because of failure to meet specifications.

The difficulties of scrap segregation increase with every handling. The source is the best point for segregation. Comparatively little time and trouble taken there will save a great deal of trouble and wasted time at the mill.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

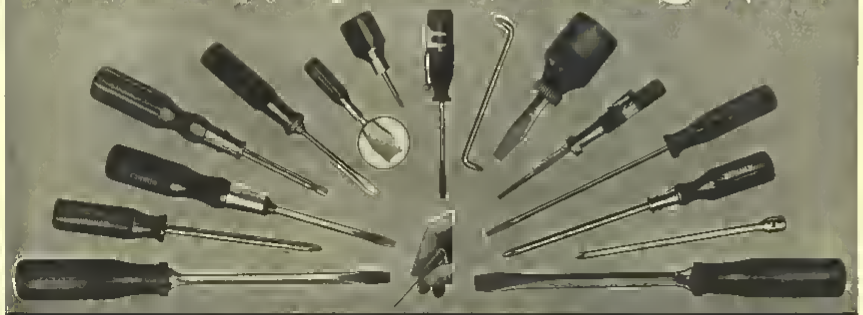
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BONNEY TOOLS

Bonney Screw Drivers . . .

to Meet Every Screw Turning Need



16 Types - 33 Sizes

DIFFERENT types and different sizes of screws . . . different applications for those screws . . . require different types and sizes of screw drivers.

That's why you will find 16 types made in 33 sizes in the Bonney Line. Every one is made to fit standard size screw slots . . . to give the utmost efficiency on screw turning jobs.

Blades are solid, forged and in one piece . . . formed with an upset shoulder against which the handles are forced (except in a few types). All blades are heat-treated their entire length, ground and polished. Tips are accurately taper-ground to insure a non-slip fit in screw slots. All blades are firmly anchored in the handles to prevent turning or loosening.

You'll find exactly the type and size screw driver in the Bonney Line to fit your need for hand screw drivers. Catalog gladly sent on request showing full line and complete specifications.

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

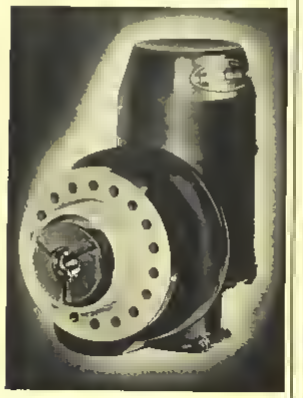
Stocked by Leading Jobbers Everywhere



60

Electric Starters

Champion Aviation Products Co., Los Angeles, Calif., has introduced a new line of direct cranking electric starters of low weight and width, and



improved safety clutch. Models for smaller planes weigh 18 lb., while those for 400-hp engines weigh but 20 lb. The highest power for its size of any equipment of this type is claimed for the new series.—AVIATION, *October*, 1942.

61

Inspection Instrument

A visual indicator comparator gage, called the "Micro Chek," designed especially to facilitate inspection of close tolerance parts, permitting rapid and economical checks with advantages over the conventional gaging methods is now being manufactured by **Trico Products Corp.**, Buffalo, N. Y. Adjustable for use on snap gaging operations, or with built-in button retractors. Although light in weight, the instrument is said to be very rugged and is not affected by oil. Tolerance limits are set for master parts, with the gaging indicator moving between adjustable points. —AVIATION, *October*, 1942.

62

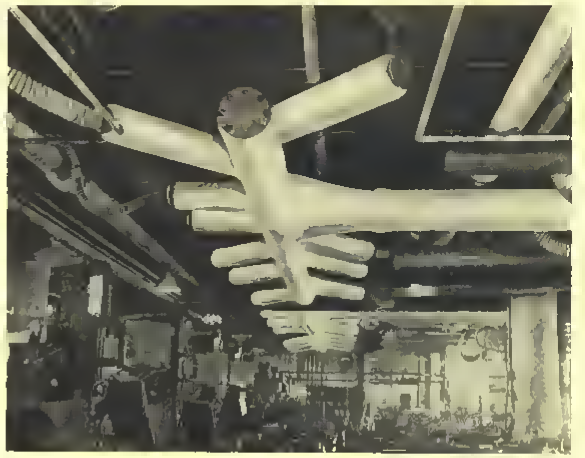
Restrictor Valves

Restrictor valves, quickly adjustable for retarding the rate of flow of liquid in one or both directions, are announced by **Bendix Aviation, Ltd.**, North Hollywood, Calif. They incorporate needle-type valves which provide annular flow passage at the point of restriction, thus reducing possibility of stoppage by foreign matter.—AVIATION, *October*, 1942.



"Outblitzing the Blitzkrieg!"

To terrorize Tokio, bomb Berlin, thousands of planes are marching off America's production lines. We're proud of our part in supplying essential annealing and carburizing equipment to back the Aircraft Industry in helping put the "Blitz on the fritz!"



Alloy Exhaust Manifold built for a large motor truck manufacturer. This manifold takes exhaust gases from motor blocks. A duplicate for second floor was built at the same time

THE PRESSED STEEL COMPANY

of WILKES-BARRE, PENNSYLVANIA

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Subcontracting

It obviously would be impossible for the little machine shop shown here to feed the necessary parts to the many Beechcraft assembly lines, some of which are not shown here.

More than 2 years ago Beechcraft initiated an extensive subcontracting program which absorbed the impact of priorities on the normal business of scores of machine shops. Loyal hardworking subcontractors now are devoting to Beechcraft's business an aggregate floor area that exceeds the total productive area of the Beechcraft factory. This has made possible the release of new machine tools to others and has prevented the dislocation by war conditions of many well-managed enterprises.

Beechcraft's experience is that properly directed subcontracting is a flexible and efficient way to increase output.

Above—Assembly lines of all-metal AT-11 twin engine Beechcraft bomber trainers



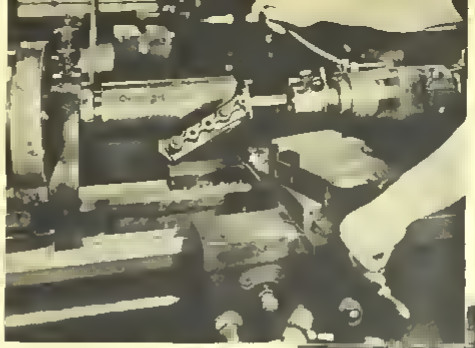
Beechcraft's Machine Shop

Below—Assembly lines of plywood AT-10 twin-engine Beechcraft trainers

Beech Aircraft CORPORATION

BEECHCRAFTS ARE DOING THEIR PART — WICHITA KANSAS U.S.A.





A 50-year old engine lathe producing class 3 threads in a heat treated chrome moly forging at the rate of 20 pieces per hour. A series of three similarly equipped lathes are used to do all of the turning operations on these parts in large quantities. Dowel pins assure accurate alignment from one jig to the next. Chasing this thread formerly required 45 min. and produced a high percentage of rejects.

Subcontractors Section

Inspection club of the young but swiftly growing subcontracting firm. All parts receive 100 percent inspection before shipment. Shelf shown at left is for arranging work in rows for the inspection operations.



★ SUCCESSFUL SUBCONTRACTING requires no old established firm; neither does it require modern or elaborate equipment.

This has been proved beyond doubt by Eugene K. Gray and John H. Stephens, who head Aircraft Products & Equipment Corporation. Less than two years ago they got their first order, which totaled $125; today they are doing $250,000 worth of business a year, are about to open their second plant—to fabricate plastic-plywood parts and gliders—and have a research program to insure their employees' jobs after the war.

Their story, told by Mr. Gray, shows what can be done by two men just six years out of college and gives further evidence that America's aviation industry can't be beaten.

SUBCONTRACTING FROM SCRATCH

Five thousand borrowed dollars plus courage and ingenuity founded a still-growing quarter million dollar organization.

By EUGENE K. GRAY

MR. JOHN H. STEPHENS and the writer started operations in a Pennsylvania city in February of 1940. Mr. Stephens was born and reared in Texas and received his Bachelor of Science degree at the University of Texas in Mechanical Engineering and later his Master's Degree in Aeronautical Science at the University of Michigan in June, 1936. The writer was born and reared in Kansas, and received his Bachelor of Science degree in Aeronautical Engineering at the University of Michigan in June, 1936.

It was at the University of Michigan that we met, struck up a friendship and discussed our ambitions to eventually have an organization of our own. The present organization, Aircraft Products & Equipment Corporation, was the direct outgrowth of these conversations held in 1936.

As graduation time neared, we found ourselves without funds or a job. We took advantage of Easter vacation to make a 2,000 mi. hitch-hiking trip through the edge of Canada, down the Eastern Seaboard and back to Ann Arbor in order to find ourselves a position to go to after graduation. Luck was with us, as we made the trip in nine days and each had the choice of three places to go.

Immediately after graduation we both entered the employment of the Glenn L. Martin Company as junior draftsmen. After working there for a year, we felt that, in the interest of our future business to be, one of us should branch out and obtain experience in the commercial aircraft field, since our work at the Martin company was strictly military. As a result of this conference, the writer took a job with the Curtiss-Wright Corporation, returning at the end of a year to the Glenn L. Martin Company.

At the outbreak of the war we decided that it was not wise to wait any longer before starting our business but to jump into the production battle for defense by opening a machine shop to make aircraft and munitions parts.

Not the least of our troubles was the fact that we had no money. This, coupled with a profound ignorance of the business world, precipitated a hectic nine months of promotion. Not knowing anyone who wished to part with his money on such a nebulous idea, we availed ourselves of the opportunity to advertise in the *New York Times*.

(*Turn to page* 191)



GETS THE JOB DONE

When You Turn to LYON for Fabricated Metal Parts

● Lyon organized to co-operate in Uncle Sam's war effort—and began training its staff for effective teamwork on this highly specialized job—nearly two years ago.

Today, the Lyon War Products Committee—backed by a nation-wide staff of specially trained field men—make every minute count when called upon to match our facilities against your needs.

Back of this efficient planning team, is an equally well organized group of plant executives, design engineers and workmen. Our modern plants provide over half a million square feet of capacity. Completely equipped toolrooms assure prompt production and efficient maintenance of all necessary dies and jigs.

So, if your War Contracts require fabrication of No 8 to No 30 gauge metal, turn to Lyon for ACTION! Write for brochure, "Craftsmen in War Production."

This Brochure will enable any producer of War Materials to determine where Lyon facilities can help speed production. A copy is yours for the asking.

LYON METAL PRODUCTS INCORPORATED
General Offices
5810 Madison Avenue, Aurora, Illinois
Sales and District Offices Manned by Experienced Engineers in All Principal Cities

The Lyon War Products Committee—which meets daily—has more than a year's experience expediting War Contracts. Its record for getting results has won widespread press comments.

LYON METAL PRODUCTS, INCORPORATED

"Wanted: $100,000 to start a small aircraft parts business."

This advertisement brought sacks of mail to Baltimore from people apparently most anxious to spend $100,000 on a small aircraft parts business. To take care of the replies, we opened offices on weekends in a New York hotel and interviewed these people by appointments. It was here that we received a complete and expensive education in the ways and habits of New York's best confidence men. Some fabulous get-rich quick schemes were proposed, and after three weeks of interviewing we had even less money than before but not one indication of any legitimate backers.

However, we did finally contact one woman with $100,000, willing to make the investment on an apparently legitimate basis. We thereupon laid the groundwork and purchased $75,000 worth of machinery and equipment. Everything progressed rapidly and smoothly for the first three months. But then the manufacturers demanded that their requests for down payments on the machinery be met at once. It took but a short investigation to reveal that we had suddenly gotten into the position of having purchased $75,000 worth of equipment without having a dollar to pay for it. We were fortunate in the next few weeks to transfer the orders for this machinery, partly to the Martin company, thereby absolving us of personal financial responsibility.

By this time we had decided to scale our dreams down somewhat and to buy for a much more modest sum with which to launch the business. Following some months of searching, we were able to raise a grand total of $5,000. After combing the East for machinery and a building we finally found a good compromise between our desires and pocket book in the plant in which we are now operating.

The machinery was approximately fifty years old and for the most part had not been operated in seven to eleven years. However, we believed it could serve as a nucleus around which to build. We came to Pennsylvania and opened our office with $3,000 (all that was left of the $5,000) a portable typewriter and letterhead stationery. With only these assets, we typed letters to the major aircraft companies soliciting subcontract work. In about a month our excitement knew no bounds when we received an order from the Bell Aircraft Company for 1 000 spacers, at a total price of $125.

To execute this order, we searched the town for a screw machine operator and found him in 61-year old Jesse Dowlin who was employed by the WPA. After a few minutes Mr. Dowlin felt quite at home, for he had operated this same machine back in 1898 and still remembered its unique temperament. However in order to maintain deliveries at a rapid enough rate, it was necessary for Mr. Stephens and me to take turns operating the machine on the second shift.

We ended our first month of operation with total sales of $375, two employees and a backlog of approximately $500. At the end of the second month we employed five machinists and had learned that our lathes bored a hole that was simultaneously tapered and egg-shaped and that all of the machines developed an inordinate inaccuracy along about the tenth hour of operation. This was due to the fact that the grease and dirt that had rusted in the bearings for the past eleven years did not come loose until the machines had run for a short while. This discovery usually brought an early end to operations. However, we were able to save the situation by personally working on the machines in the daytime and typing letters and doing the office work at night. As the months passed, more orders came in, more men were employed, new machines were purchased until the old machines were gradually but completely rebuilt to the point where we had a smoothly running organization of 50 people.

It was by making almost any old machine or piece of equipment suffice for the job that we got our start. From the earnings and reputation gained by the use of makeshift setup we were able to purchase new equipment and secure more than ample orders to keep them busy.

In order to utilize the surplus of old machinery that was limited in its flexibility of operations, we found that our past engineering training was very valuable. By designing special jigs and fixtures to fit our old equipment, we were often able to accept jobs that normally would be done on new machines costing a small fortune.

This type of planning, for example, was found to be particularly adaptable to old belt driven engine lathes, of which there is still a large surplus throughout the United States. These jigs and fixtures usually have about the same characteristics, i.e., great rigidity, rapid loading and unloading, stops and tool setting pegs can be built in the jig to insure correct dimensions of finished

Subcontractors Section



Are you interested in: (1) Reducing time and cost of handling tools and materials, (2) Saving floor space, (3) Increasing protection against fire, sabotage and personal injury hazards?

This comprehensive catalog contains many suggestions for meeting these war-time problems. It illustrates and describes many types and sizes of shop boxes, work benches, portable tool stands and many other items that manufacturers of Airplanes and Airplane Parts are finding most effective in every production operation.

Mail coupon today for your copy of this useful book.

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General Offices: 5809 Madison Ave. Aurora Ill.
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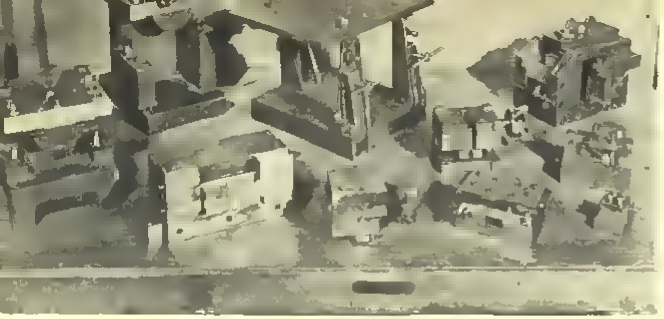
LYON SHOP EQUIPMENT *Service*

LYON METAL PRODUCTS, INCORPORATED
5809 Madison Avenue, Aurora, Illinois
Send FREE copy of Lyon Shop Equipment Catalog

Name_____

Address_____

City_____ State_____



Drill jigs and milling fixtures designed to insure accurate work on old machinery tools. The large jig in the center shows the use of welded construction for lightness and the use of castings to minimize tool making time

part, provision can be made to prevent the part from being placed in jig backwards, etc.

By establishing three or four lathes equipped in this manner in a row, a production line can be set up where the first operator performs one operation and passes the part to the next man for another operation, and so on. While this method is not as efficient per man hour as having large turret lathes, it has the advantage of allowing three men to work on the part simultaneously, thereby producing substantially more per hour than a single turret machine. This system also permits the use of less skilled men to produce a rather complex part. However, the most important advantage is being able to use old engine lathes (which, except for presses, are the most idle machine tools in this war) to do the work of one of the most unavailable machines, the large turret lathe.

We found that it is possible to do a large volume of rather accurate work on old screw machines by making lavish use of the centerless grinder. To do this, it is not necessary to own such a machine, as centerless grinding can be farmed out at a very low unit cost. We seldom work our old screw machines to a .001 tolerance. Instead, we furnish the shop with a special drawing with a wide tolerance, place a bonus on the job and knock the parts out at a fast rate. These are then ground at a cost of approximately one to two cents each.

We found another substitute for the screw machine in the multiplespindle drill press by using specially designed fixtures that hold the part in such a manner that several operations can be performed in one chucking, thereby producing accurate concentricities and dimensions. In designing these jigs, it has often proven advantageous to use aircraft design so that the jigs are rigid but light. This permits the operator to handle the fixture all day at a fast pace and not become too tired. Wherever possible the fixtures are made from cast iron and cast steel. Besides making the best jigs, this type of design saves hundreds of hours of tool making.

At the end of the first year's operation, we were honored by being selected as the first organization to receive "The War Production Award of Merit." A half-hour program was devoted to the presentation over Station WCAU in Philadelphia. This award came at about the end of the awkward and struggling stage of our founding, and marked the beginning of a more matured and smoothly operating organization. By this time both Mr. Stephens and I were under doctor's care and were forced to take short vacations to regain some lost poundage.

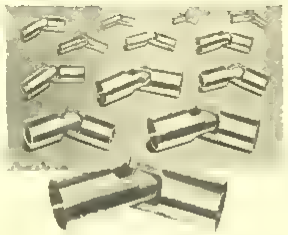
We were able to procure most of our employees from West Chester. Some of the men came from the WPA, some were janitors, some were butlers, some just gentlemen of leisure, still others came from the local classes in defense training. It was found that what these men lacked in urban sophistication they made up in loyalty and the desire to create a going concern.

They have a pleasant philosophy of life which is perhaps unique to a rural Quaker community. They believe in applying themselves diligently to their task for a certain number of hours and then using the rest of the hours of the day for family and community pursuits.

Almost all of the machinists from West Chester who helped start the company are still with us.

A year and a half after getting our first order for 1,000 spacers, we are producing at the rate of $250,000 annually in war products and are still growing. New machinery has been purchased out of earnings, a modern and well equipped inspection department has been organ-

There is a DIX UNIVERSAL JOINT for Every Purpose



Let DIX engineers help solve your problems. The high quality alloy steel used in DIX Universal Joints is treated and hardened to correct degree, machined and ground to microscopic accuracy to produce perfect functioning under all conditions.

Specify DIX Precision Made

UNIVERSAL JOINTS

DIX Aviation Type Universal Joints made to Army, Navy and Air Corps specifications are used by practically all aviation plants and are daily proving their outstanding quality under toughest war conditions. 3 complete production plants to serve you.

Write for special literature and detailed data

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PRECISION MADE PRODUCTS DIX

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Proven Performance in

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AIRCRAFT PRODUCTS & EQUIPMENT CORP.

WEST CHESTER, PENNSYLVANIA

MORE WAR WORK WANTED

-SHEET-METAL WORK
-STAMPINGS
-SUB-ASSEMBLIES

Take advantage of Continental Can Company's resources, facilities and organization that are now helping many industries solve their war production problems.

TODAY WE ARE PRODUCING WAR MATERIAL as prime and sub-contractors in many of our plants throughout the country. The manufacture of war items by mass production methods is made to order for our plants and personnel. Here is where our 57 years' experience in making metal containers works to advantage. We have recently prepared a portfolio showing the highlights of how our experience and organization are fitted for war work. We will be glad to send a representative to review it with you.

Here is what we offer:

▶ 45 plants conveniently located from coast to coast.

▶ 7,738,500 square feet of floor space, part of which is available for additional war work.

▶ 16,000 workers (including machinists, engineers, draftsmen, tool and die makers) skilled in mass production of metal units.

▶ A competent sales staff operating out of 27 local sales offices which expedited the handling of an annual business in 1941 amounting to $136,652,016.

▶ A War Products Council organized to give you quick action to help you or tell you promptly what you want to know about Continental's ability to handle any job. Write, wire or phone War Products Council, Continental Can Company, 100 East 42nd Street, New York City, or any sales office.

NOTE: *Continental is still turning out "packages to protect America"—cans to carry needed food to our armed forces, to our Allies, and into American homes. We will continue to make these cans—as well as other containers for essential products as defined by WPB.*

CONTINENTAL CAN COMPANY

100 EAST 42nd STREET, NEW YORK CITY

Sales Offices in:

BALTIMORE, MD. CHICAGO, ILL. CINCINNATI, O. DENVER, COL. DETROIT, MICH. HOUSTON, TEX. JACKSONVILLE, FLA. JERSEY CITY, N. J. KANSAS CITY, MO. LOS ANGELES, CAL. MALDEN, MASS. MEMPHIS, TENN. NASHVILLE, TENN. NEW ORLEANS, LA. OMAHA, NEB. PASSAIC, N. J. PHILADELPHIA, PA. ST. LOUIS, MO. ST. PAUL, MINN. SAN ANTONIO, TEX. SAN FRANCISCO, CAL. SEATTLE, WASH. SYRACUSE, N. Y. WHEELING, W. VA. WILKES-BARRE, PA.

We're 'OVER THERE,' Too! . . .

Yes, we're 'Over There' . . . across the oceans and seas where gallant men are dying to protect the democratic way of life.

Wherever our armed forces . . . and their heroic allies of the United Nations . . . are fighting — there you will find products produced by the skilled craftsmen of Aircraft Mechanics, Inc.

From lathe grinder and our milling machines . . . from our welding booths . . . and out of the thundering jaws of our air forges — pours a mighty river of vital aircraft parts, destined first to the hungry production lines of this nation's foremost aircraft manufacturers; then to far-flung battle fronts.

We're engaged 100% in producing 'Over Here' so there will be enough 'Over There.' It is probable though, that we can find the facilities, the space — and the time! — to produce for you, too. Just drop us a card. Our engineers will give you the information you want . . . immediately.

Many workmen have come to healthful Colorado Springs where they are pleasantly and profitably employed in our expanding plant.

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ized and installed, and troubles from rejected material are practically nonexistent. We maintain both crib and roving inspectors. The roving inspectors check each man in the shop once every hour, the crib inspectors make a 100 percent inspection prior to shipment.

Now that our company is well on its feet, we are laying plans to open a second plant in the very near future to fabricate plastic plywood products for the aviation industry and to produce gliders constructed largely from plastic plywood. Both plants will then operate in close conjunction with each other.

Along with war work, a research program is being carried out to insure work for our employees at the cessation of hostilities.

Men and Machinery Available For War Work

Small business concerns throughout the country are still looking for work which will speed the nation's aircraft output, and prime contractors are still seeking organizations who can contribute parts or subassemblies.

AVIATION will continue serving as a clearing house for information on men and machines available for war work. Address all inquiries to AVIATION, 330 W. 42nd St., New York, N. Y., mentioning the key number given each item.

123. A pool of 38 plants in an Indiana city with 22½ percent of their facilities now engaged in war production—some of it for the aircraft industry—offers them facilities for a wide range of precision work. They have over 2,000,000 sq. ft. of floor space available, more space can be made available when it is needed. Machine tools include 25 bending machines, 128 drilling machines of different sizes, 39 grinders, 38 engine lathes, 16 turret lathes, 6 screw machines, 25 milling machines, 29 plating and polishing machines, 53 presses, of which three are over 100 tons, 7 shapers, 5 tapping machines, 15 arc, 35 spot and 29 [illegible] machines.

124. An experienced Massachusetts metal working shop offers the following equipment in the tool department—ten lathes, five milling machines, nine grinders, six drill presses; five planers and shapers, in the production department—eight turret lathes, eleven drill presses, three lathes, three milling machines, eight miscellaneous machine tools and heat treating equipment pieces. Also a complete inspection department.

125. A Minnesota equipment manufacturer has the following equipment available for delicate, precision work: Four Hanging precision lathes, a miniature milling machine, a miniature gear hobber, a Barber Colman No. 2 gear hobber, complete grinding and lapping equipment and a number of milling machines, tread lathes, engine lathes and other machine tools.

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We are challenged nowhere so strongly as in the *air*. And rising to give the answer are thousands upon thousands of our young men—Galahads and Lancelots of holy purpose, their Grail the freedom of mankind, their steeds of steel wheeling in deadly tournament amid the meteoric dust.

No one has ever lived who knew the equal of their courage. And no people have ever had a stouter barricade against a foe. As our aviators fling themselves into that ultimate and decisive battleground—the sky, soaring with them are the hopes of the Democracies of the world.

They are not only fighting, they are "going to school" in a new realm where the scale of man's thinking is large. They see at first hand how small is the world, how easy to fly around it, how petty and futile its fences and boundaries, how inadequate its old yardsticks of distance, and how pinched is yesterday's concept of geography.

Their heroic task accomplished, these airmen will be returning to a new world of their own making, to the world *we* shall live in tomorrow—the world of the air as well as of land and water. The Vultee trainers in which they were cradled and the fighters and bombers in which they utilized their skill will sire planes of Peace. And the universal air will vibrate with their promise of things better far than we have known.

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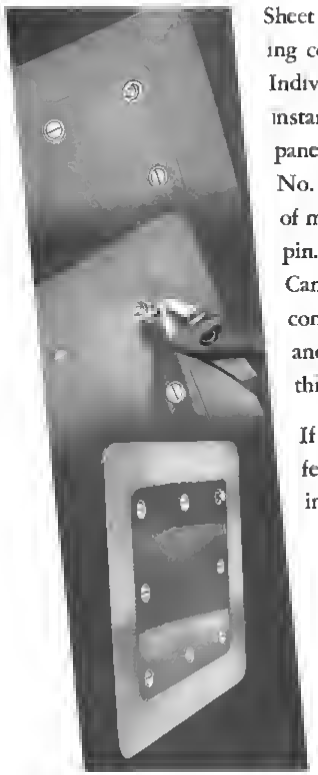
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Side Slips

• YOU CAN HAVE your wars and rumors of wars and your controversies over the performance of combat planes, but in aviation news we'll take Igor Sikorsky's story on what the helicopter will do, come peace. He tells all about it in the September ATLANTIC MONTHLY, a celestial old magazine in its 85th year.

Evidently Mr. Sikorsky has been pending some of his time the same way we spent ours as a boy in Lasalle, Ill.—but with much more practical results. We had a job on a wheat ranch out there, where the sun set behind a lovely green mountain. Instead of shucking bundles as fast as the farmers reaper chucked them out, we got to dreaming about a vertical lift flying machine—an idea that had no name at that time. As we recall, the Chalmers and Lozier cars had just come to our valley, along with the "Wages of Sin."

Our machine was made out of number one hardware, it had Dutch windmills for rotors, a Stanley Steamer engine, and a sort of river-boat pilot house. But essentially it was the same as Sikorsky's. We could "hover and fill our cars with an enchanting rustle," and "bring joy to the soul," exactly as the great Russian inventor says he can do with his new V-300.

At last the farmer complained he rose we fell about 30 acres behind his barvest operations. But when we finally failed to hear the supper bell and stayed out in the field, hovering over a mountain knuckle-burr patch in our machine, instead of oiling up the cream separator, he fired us.

Several dozen thousands of tinkering-minded people have longed to burn in the air and fill their eyes with enchanting vistas—thousands never mentioned in the whos who of science. Mr. Sikorsky we think is pretty much like those unknown people. He wants to float south over high ridges covered with aspen trees, and settle down in little glades and try a fish by the creek.

But he had something more substantial than daydreams and wishes. On top of scores of other arduous jobs he found time and energy to hammer out the facts and parts that probably will make up the machine that so many thousands have wanted. It wasn't an exciting, exploring sort of job either. Lots of other people had worked on it, were all the new stuff of it. Sikorsky had to ride an old and tiresome trail to get where he wanted to go.

His accomplishment is marvelous, when you think of it. For the first time in history, a man whose technological opinions are respected like those of Ford or Edison or Firestone, says he can bring the human race pretty close to what they've been joyfully imagining. He says helicopters will build up to a billion dollar industry; that they will cost about the same as medium cars, that they will travel at 140 mph; carry up to 20 passengers, and all sorts of perishable cargo from out of the way places, up to 200 mi. Beyond that distance, he leaves the future to airplanes.

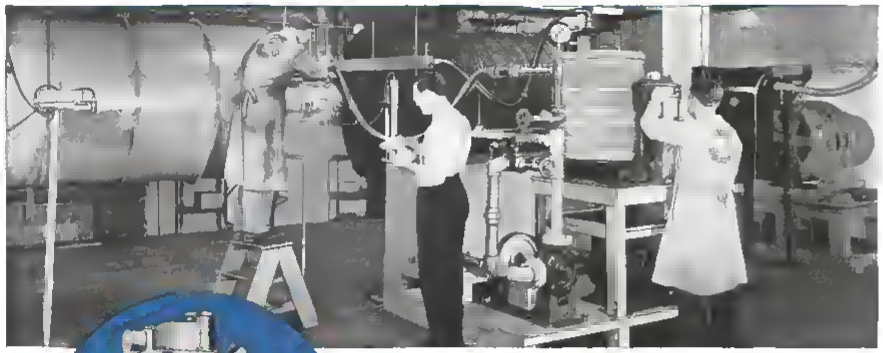
Well, we certainly want one of his flying machines. There is a sandbar in the bottom of the Salmon River country, out in Idaho, that we never could climb down to, because the walls are too precipitous. The sand looked as if it might be full of placer gold. We want to whirl down in there with a helo, and see about it.

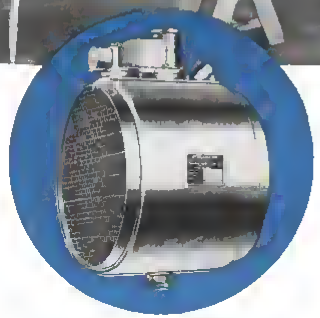
• WE HEARD the other day that RAF fighter pilots have a new technique for handling enemy submarines. They apply a sort of "helicopter principle" to them with rather startling results. When they sight a periscope they drop a barrel of green paint on it. The sub commander, thinking he is still well submerged, sets his elevators up and starts to rise. He keeps rising and rising, and when he gets up to 2000 ft., the fighter pilot shoots him down.



"Mr. Maguire is trying to sell them the idea of enlisting in the Navy's blimp patrol!"

"We Dare Not Fail"

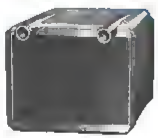




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HEAT TRANSFER PRODUCTS

Aviation's Dividend Prospects

By SELIG ALTSCHUL

PIONEERING rarely pays immediate dividends The aviation industry affords ample evidence of the patience required and the continuing delay before tangible returns are realized

The development of the aircraft industry has enriched the national welfare and now represents the keystone of our country's war effort. The financial history, however, is far from heartening to a great majority of stockholders in this group

When the aircraft industry first began to achieve an aura of respectability in investment circles, the promise was held forth that here was a new development on the threshold of great expectations Public acceptance was quick to follow as the "romance" aspects of the group were easy to visualize The ever widening importance of military and commercial aviation appeared to give substance to even the most exaggerated claims of the times Indeed, the ultimate growth of the aircraft builders widely exceeded many of the optimistic projections advanced The accelerated tempo of war preparations throughout the world and more than any one conflict were mainly responsible, of course, for the physical expansion of the industry But this circumstance also shaped the fiscal policies of the aircraft group With the government supplying the orders and in most instances, funds for the plant additions, the industry had a public trust which made the interests of the stockholder very incidental

The glowing prospectuses of the late thirties extolling the outlook for aircrafts, took little, if any, cognizance of profit restrictions, high tax rates and all other concomitants of a war economy which are now the unhappy lot of the equity holder

Fortunately, we now have a great aircraft industry producing with consummate skill and efficiency Its ownership and control, however, are somewhat scrambled between the government and private capital But throughout the industry's meteoric growth, the stockholder has been patiently standing by in the hope of receiving some hand-out—something tangible, rather than colorful brochures telling him what beautiful planes his company is producing

Then, too, a familiar pattern has been traced making a high rate of operations and earnings items of but academic interest to the stockholder After the initial phases of pioneering had been successfully passed and an aircraft unit began to show some earnings, the plea was made that such income must be retained in the business to help provide capital for future expansion. Later, "contingency reserves" of all kinds began to make appearances and effectively minimized dividend payments The reserves continue and to them have been added the restraints and unknown effects of taxes and contract renegotiations All this conspires to delay or reduce dividend disbursements to the equity holder

Not all stockholders have fared alike Much is dependent upon when commitments in the industry were made The aircrafts, as a group, were at their low point during 1936 and the early part of 1937 Anyone astute enough to have made purchases during that period and retained such holdings would have no cause for regret, even today However investments made at a later time, say 1938, 1939 and particularly 1940, were made at relatively high levels and in many cases at or near the peaks It is this group which has been hard hit as current prices are generally about one-half of the prices originally paid Moreover, as indicated by the volume of unfilled orders in aircraft issues, it is a safe surmise that the bulk of present stockholders made their commitments at much higher levels and now show unrealized capital losses on their investments

The small dividend payment in relation to available earnings are clearly indicated by Table I. While earnings began to appear, in many instances, by 1936 it was not until 1939 that the group started to demonstrate some material profits This becomes very obvious by comparing the separate three-year periods as afforded by the table It is readily apparent that the group's earning power was negligible for 1936 through 1938 inclusive and was concentrated in the 1939-1941 period Moreover, most dividends were first initiated in 1939

It is interesting to note that Douglas is currently selling at a price equal to the accumulated earnings of the company for the past six years Also, the company has paid out less than one-tenth of its earnings during the previous three years

The records of the other companies shown further substantiate the contention that aviation stocks should rarely, if ever, be purchased for dividend income.

A few case reports illustrate the current dilemma of the aircraft industry in deferring or reducing dividend payments

The Aviation Corp., in spite of a sharp increase in earnings, has deferred action on dividend payments until a reasonable forecast of earnings can be made ' After provision for federal taxes totaling $3,100,000, based on a combined rate of 45 percent for normal and surtax and a 90 percent excess profits tax, the company reported net earnings of $2,478,291 or 43c a share for the six months ended May 31, 1942 This compared with total federal taxes of $273,979 and net earnings of $662,234 or 11c a share for the like period a year ago

The restraint on dividend payments by the Aviation Corp. is attributed, among other things, to the uncertainties of selling prices of products, proposals for price ceilings on materials supplied by prime and subcontractors, and efforts

TABLE II—BARRON'S STOCK AVERAGES

	All Aircrafts	All Transports	50 Stocks
Aug 28 1942	29 12	29 28	60
Aug 21 1942	29 10	29 75	59
Aug 14 1942	28 95	30 00	59
Aug 7 1942	28 60	29 19	58
Aug 29 1941	38 33	39 53	74

TABLE I—AIRCRAFT EARNINGS AND DIVIDENDS

	*Accumulated earnings per common share 1936-1941 Inclusive	Accumulated earnings per common share 1939-1941 Inclusive	Dividends Paid Per Com Share 1936-1941 Inclusive	Market Price Sept 1 1942
Bell	$7 38	$6 78	$1 00	$12 75
Boeing	1 13	1 13	none	16 50
Consolidated†	10 04	8 27	3 75	16 50
Curtiss Wright	3 30	3 75	1 50	7 125
Douglas	60 55	53 31	13 00	60 75
Grumman†	8 93	6 73	3 50	30 25
Lockheed	11 49	7 41	4 50	17 375
Martin	18 36	14 18	0 90	30 75
United Aircraft	19 98	15 03	9 00	28 25

Notes

* Includes contingency reserves wherever present

† Adjusted for 100% stock dividend in Oct 1941 Periods are for 11 months ended Nov 30 1941 and calendar years for prior periods

‡ Adjusted for stock dividends.

toward wage stabilization in the industry. The new tax rates used are by no means certain, but the company appears to have made ample provision for this contingency.

Incidentally, it is noteworthy that the company suspended the extra compensation annuity plan which involved a distribution to officers of a percentage of earnings. Instead, upward salary adjustments have been made. This extra-compensation plan, while officially approved, was the center of outspoken criticism at the company's last annual stockholder's meeting.

Another interesting case history is that of the Boeing Airplane Company. Last year this company reported its first material profit since its existence, showing a net profit of $6,113,144 equal to $5.65 a share. This compared with earnings of 34c. a share for 1940. Vastly expanded production continues and despite increased taxes and price adjustments, the company is expected to finish the current year with a net profit as good and possibly better than for 1941.

Yet Boeing paid a dividend of only $1 a share a few months ago—its first since December, 1937, when 40c a share was disbursed. However, another dividend payment is anticipated by informed sources later this year when "the financial situation can be seen more clearly than at present."

The Boeing financial history, as reflected by the market, has run counter to the aircraft group as a whole. Peak prices were paid for Boeing stock in 1937 at almost $50 a share. Since that time, it traced a general decline which leveled off at 12¾ in 1941. Boeing is the last major aircraft company to emerge from a long string of deficits and succeed in making the profit column. This may be attributed to the extensive experimental work and adjustments required on U. S. business.

This research has paid important dividends of another form by giving our nation *Flying Fortresses* which have distinguished themselves in every theater of operations. Research continues, and Boeing is reported as spending $1,000,000 for a wind tunnel. At the same time, a new research program looking to post-war developments has also been undertaken. Constructive research projects ultimately benefit the stockholder and should be encouraged. More importantly, the stockholders of the United States invariably become beneficiaries of the research programs undertaken by the aviation industry.

The United Aircraft report for the quarter ended June 30, 1942, is a case in point. Maintaining it is a Navy contractor, the company did not submit to Army censorship. The results shown are a tangible demonstration of real production. Further, the thorough financial breakdown is cheering for those interested in the company's affairs. How completely uninformed the public remains on aircraft financial developments was revealed by the smart rally in the stock of United Aircraft following release of its report.

It is this observer's belief that more representative values would prevail in the market place, if more information were made known on the affairs of the individual aircraft companies. At best, the world be investor is utterly confused and must guess as to the status of the industry and as a result is inclined to give the group the go by and remain on the side-lines.

Dividend action by the separate airline companies will soon become a subject of keen interest to many observers. In many respects, the growth cycle of the airlines may be expected to pattern that of the aircrafts. The air transports too, had difficulty in establishing profitable operations. Further, despite the substantial expansion experienced by the group, future growth requirements dwarf the imagination. Hence, the normal tendency may be for the retention of earnings for capital expansion. Moreover, the CAB, in its recent decisions, has strongly discouraged dividend disbursements and has noted the necessity of utilizing earnings for the future development of properties.

The fact remains, however, that the air transport industry will have great need for extensive sums of capital—far greater than what can be supplied by current earnings. Some attraction, other than promises of a brilliant future, must be advanced to obtain proper investor support when needed. This circumstance may lead to a number of "token" dividend payments by a number of airline companies, earnings permitting. The whole subject of future airline financing is as yet too involved to be certain of a clear-cut pattern. It is clear, however, that equity financing will be resorted to at least in part and current practices will be influenced accordingly.

At the present time the airlines, as a whole, find themselves in excellent financial condition. Earnings are sustained and good. In most instances, large cash balances are available from the sale of equipment to the government.

It must be noted that while the industry is not losing any money on its government work, the bulk of its earnings are currently being derived from normal commercial operations. This is an interesting note as the earnings of the aircraft industry, for example, now come almost completely from work performed directly for the government. The airlines, on the other hand, find their business very good, not because of direct federal contracts but because of the indirect stimulation due to the war program. Demand for air travel is constantly heavy. The extremely high utilization of equipment with its tremendous leverage on earnings has made for profitable operations despite fewer planes available for normal service. Also, as noted a few months ago, the group has a favorable tax status, being subject to a top rate of 45 percent for combined normal and surtax levies and exempt from excess profits taxation. Under these combined factors, a strong case can be presented for dividend payments, albeit small, from current normal earnings.

No dividend disbursements, however, may be anticipated from cash received on the sale of equipment. In many instances, these funds are earmarked in special reserve accounts to be used for replacement purposes.

It is difficult to estimate final earnings for the year for the separate airline companies. The last "normal" period for the group may be said to have been the first five months of this year. The constant adjustments in the nature of the operations in the industry make any future earnings projection without value. *Based on reported results thus far, however, it is likely that 1942 will see more dividends disbursed by airlines than in any previous year.*

A brief resume of the dividend history of the airlines reveals the long wait stockholders have had for income payments.

American Airlines, the first major line to develop sustained earning power, paid $1 a common share in 1940 and $1.50 on the same stock in 1941. At least $1.50 may be looked for again this year and possibly more.

Chicago & Southern Airlines, much to the surprise of the investment fraternity, recently paid 50c on its common stock. The previous payment was 15c. a share in June, 1939.

Thus far Eastern Airlines has not declared any dividends. Current earnings safely permit a payment, but it is likely the company will await final CAB action on its air mail rate case before it considers any dividend action.

Northwest Airlines paid 50c a share on Sept. 1, 1942, on its present stock, the first payment since a disbursement was made on the old stock in 1937.

TWA last paid 25c a share in 1936. While earnings could permit a payment this year, it is considered unlikely that any such action may be taken. With the Hughes' interests as the main stockholder, the company can clearly look to long range planning without concern to

(*Turn to page* 309)





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This exclusive picture series made at a base somewhere in the northwest shows how the teams are groomed to take their B-17 *Flying Fortresses* into action.







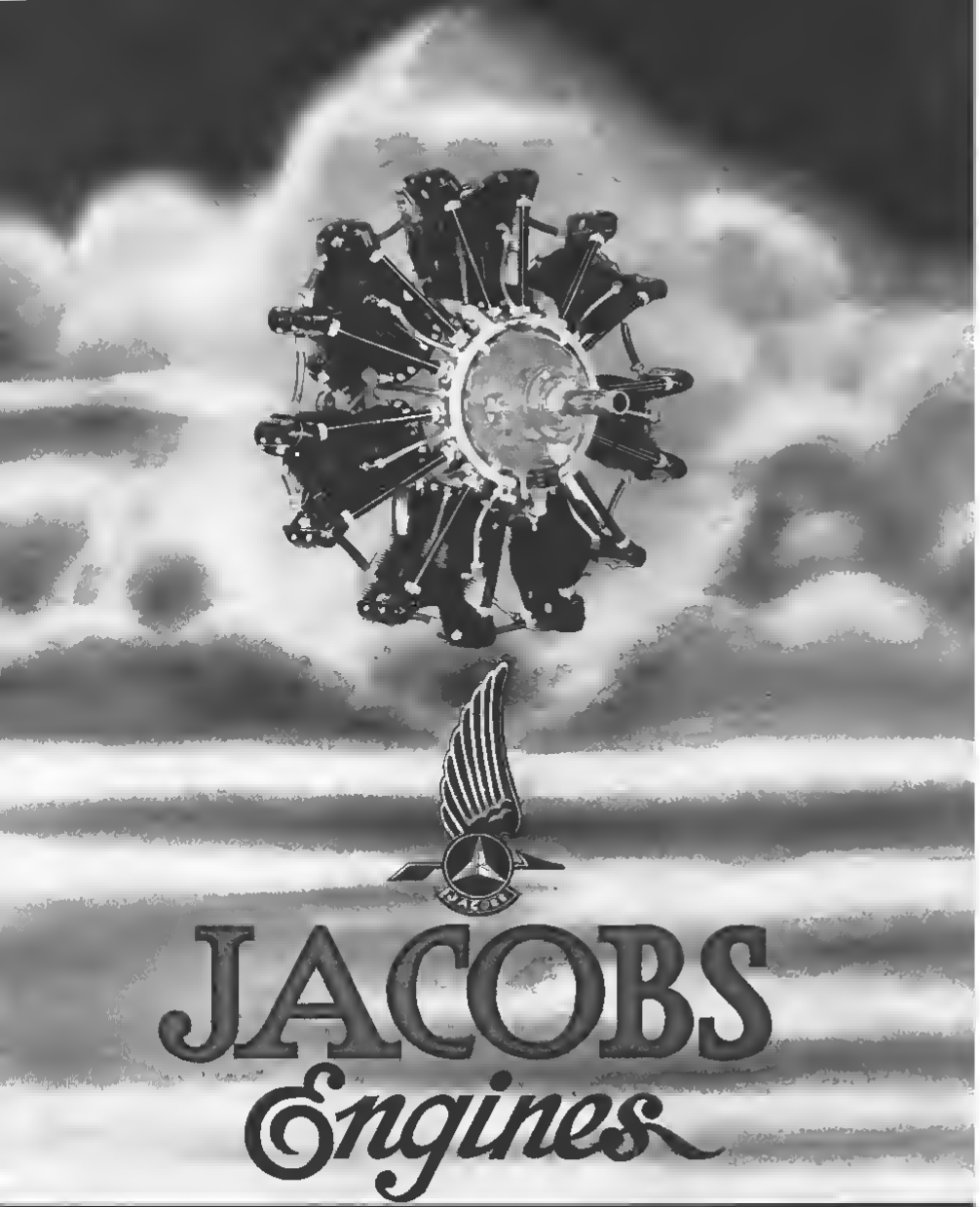
Photos by Gordon WWII U.S. ...ol Ed Johnson

Army Air Forces mechanics give every engine a thorough inspection after every flight. Here they put to use all their training—many received it right in the factories—so the bombers can get back in the air at the quickest possible moment.

—se e thre nts toughout the

On the line getting a full load of gas. Here it's for a practise mission but on more and more battlefronts throughout the world the scene is being duplicated for the real thing. With typical American affection for machines the "Flying Fortresses" get nicknames—Yankee Snuzzy Suzie Q, Esmeralda, Cactus Sal, Nippon Miss, Rattler, Dry Martini—anything to suit the crew's fancy.

Meanwhile an ordnance specialist checks and loads the machine guns—from the nose to the "stinger" in the tail—which have proved so effective against Jap Zeros and the pride of Hitler's Luftwaffe, the Focke-Wulf 190. Here a top turret is checked as part of the routine of getting the plane ready for another raid.



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Military

LEFT To make sure the bombs will land where they will be the most effective Here the bomb sight officer (center) turns the bomb sight over to the pilot and bombardier of one of the Flying Fortresses Immediately upon completion of the flight the bomb sight will be returned to this officer who will keep it under heavy guard.

BELOW Taking on the bombs These are 100 lb. practice bombs arriving on their special trailers but the procedure of loading is the same as that which the crews will soon be going through—on most any front—with the big fellas.





ABOVE Getting upstairs Below and behind lies the field ahead and above a job to be done Here with full tanks ammunition- and bomb-racks the B-17 s wheels retract as the pilot sets the course for the bombing mission perhaps a simulated outline of an industrial plant perhaps the outline of a battleship near the advanced training base somewhere in the northwest

BELOW The run With huge bomb bay doors open three Flying Fortresses make their run over the target more than 16 000 ft. below. The bombardier has been waiting a long time for this moment but his part of the teamwork is just as important as that of the mechanics who serviced the ship or the pilots and navigator who brought them over the target





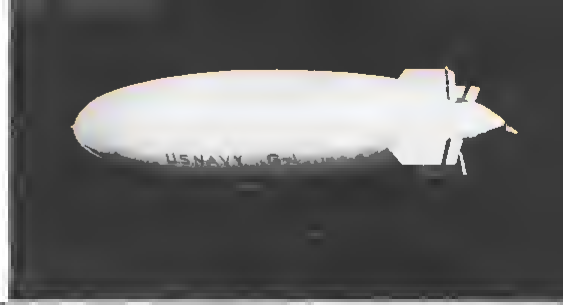
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PASADENA, CALIFORNIA, U. S. A.

Blimps of the Naval Coastal Patrol are assuming more important roles in the all important daily grind of the submarine patrol. Here is how a submarine on the surface appears to the crew of one of the Navy's modern blimps. BELOW RIGHT. Today's blimps are a far cry from their predecessors which served in the submarine patrol off our East Coast during the first World War. Blimps of the K type shown here have a gas capacity of some 416,000 cu.ft., nearly three times the capacity of the World War I blimps; can cruise over 2,000 mi., have a top speed of over 75 mph., carrying a crew of eight.







BLIMPS RETURN TO THE WAR

Work of Naval lighter-than-air craft on submarine patrol presages renaissance of nearly-forgotten weapon.

By R. G. PICINICH, JR.

THE NEARLY-FORGOTTEN BLIMP is staging a come back, a come back which has been largely unheralded behind a veil of censorship.

The Battle of the Atlantic, brought within sight of our East Coast by Nazi submarines, has inaugurated a renaissance of lighter than air craft which adventure hope may prove what they as a minority have contended through years of struggle: that the airship has as much a place in the air as has the airplane.

And from now on, lighter than air men say, blimps of the Navy Coastal Patrol will give a better account of themselves. Not that they haven't done a good job thus far, it's simply that not enough have been available. This was indicated when the House of Representatives boosted its Naval Affairs Committee recommendation for 72 airships to 200 and eliminated the words 'non rigid' so that the Navy might have authority to build rigid ships as well as blimps.

Since the first World War, blimps have been improved greatly in speed, carrying capacity and cruising radius. Noninflammable helium has replaced hydrogen gas. The 1918 wartime blimps were little more than pointed gas bags with airplane fuselages suspended below by long cables to keep gasoline sparks away from the hydrogen. The modern Navy blimp is sleek and streamlined, has space for radio and navigation departments, galley and sleeping quarters. It carries a crew of eight, can reach speeds of more than 76 mi. an hour, cruise for over 2,000 mi., and can base in the open on mooring masts for days or weeks at a time. Ships of the K type have a capacity of 416,000 cu. ft. of helium, nearly three times that of the average World War I type. A number of this class are now being delivered to the Navy for the coastal patrol.

There has been nothing developed since World War I to detract from the value of today's blimp. In the specialized field of inner coastal patrol and convoy, it can still take off in low ceiling weather inoperable to other aircraft, it can fly slowly, and if necessary, hover over a spot. Today's blimps can land on the water, anchor there—or take on fuel, supplies and personnel from a passing ship, in flight, and pick up water as ballast from the ocean.

(*Turn to page* 306)

Speaking of Responsibility

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FOR THE AVIATION INDUSTRY

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

LOCATING IGNITION TROUBLE

Not all difficulties, including "rough engine", should be blamed on spark plugs since easily-located causes may occur in the harness.

By H. N. WALKER, Ph. D. *Director, Ignition Research, The B. G. Corporation*

THE LOCATION OF IGNITION troubles is part of maintenance procedure that be both quick and simple, provided modern test methods are employed. Not all such trouble, however, should be automatically charged to faulty spark plugs, for they are but one part of the complete ignition chain

Nevertheless, any discussion of the ignition problem must consider the spark plug, since cylinder pressure and temperature and width of gap setting and spark advance influence not only the plug, but also the performance of the ignition harness

The purpose of the ignition harness is to convey high tension electrical energy from the magneto to the gap of the spark plug with a minimum of loss, and to produce a spark discharge by breaking down the cylinder dielectric.

Let us consider individually some of the factors enumerated above which influence proper operation of the spark plug and the ignition cable

First there is cylinder pressure The effect of this pressure on the voltage required to break down the spark plug is exceedingly important For a given gap setting, greater voltages are required to break down the dielectric as the cylinder pressure increases The relationship between breakdown voltage and pressure is substantially a straight line

Second, there is cylinder temperature The effect of cylinder temperature influences the length of core exposure chosen and consequently the spark plug selected for a given engine The temperature at which a plug operates is largely influenced by the length of core exposure However, other factors also must be considered in spark plug design A plug with a short exposure is designed to operate in a hotter engine than a long-exposure plug The short exposure has less mass to become heated, and more readily transfers its heat by dissipation through the copper gasket to the cylinder than does the long-exposure spark plug In general a cold plug will foul more easily than a hot plug but a condition of preignition can result from operating the plug at too high a temperature.

Third, there is gap setting Increasing voltages are required to produce a spark between the center and the ground electrodes as the gap is widened with cylinder pressures maintained the same

Fourth, spark advance The effect of increasing spark advance resolves itself into consideration of cylinder pressure variations and its consequent demands of magneto voltage to produce the spark discharge The engine operator is not in a position to control this variable as it is a design function

Rough engine operation complaints are frequently attributed to spark plugs, and the argument is heard that after the "faulty" plugs were replaced with new ones the engine operated satisfactorily for a time, but subsequently the trouble recurred Replacement of this second set of "faulty" plugs with new ones again afforded temporary relief. The deduction, so this argument goes, is therefore evident—the spark plugs were no good

Consider Entire Ignition System

Let our approach to an understanding of this situation be more critical and inclusive of the entire ignition system—let us look at the ignition leads and the condition of their insulation, all elbows and sleeves and the length of cable exposed within the sleeve, as well as the alleged offender, the spark plug These factors are, as it were, all links in a chain, admittedly there is little reason to blame the last link of a broken chain

(Turn to page 300)

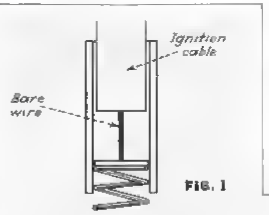
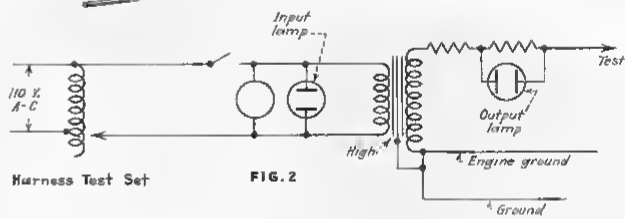


FIG. 1



Harness Test Set FIG. 2

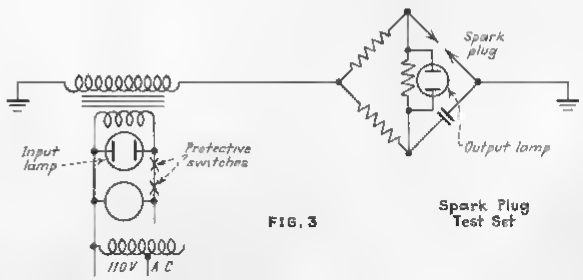


FIG. 3 Spark Plug Test Set



PORTABLE ENGINE DOLLY

Mechanics at the Enid (Okla.) Army Flying School getting ready to lift an engine from a portable engine dolly preparatory to installation on a plane.

Front Repair Job Grows; Parts Schedule Difficult

Maintenance of warplanes becomes a bigger job as more equipment goes into action. This includes getting the engines and parts to the front and the actual repair jobs done under battle conditions.

Army and Navy air arms both have a hard problem figuring what percentage of parts to schedule with a given delivery of finished planes. Different types of planes take different total percentages of parts.

For example, a four engine bomber might require spares of 17 percent of total parts in the plane, while a fighter plane might take more or less. But the total percentage of spares is not the whole story. One type may need a larger proportion of spare wings than of wheels, or propellers.

Again, the same plane assigned to different parts of the world needs different repairs. More extra engines and parts are needed in South Africa because of the sand, than in other places.

An air filter, essential in Africa, will not work at all in sub zero countries; it makes ice.

Repairs at the front are made by mobile service units. Most combat plane manufacturers maintain master mechanics men at the front to give instruction.

Typical of these maintenance units is a unit which the Wright Aeronautical Corp. has stationed on the African desert. In the large truck which contains the machine shop there is an electric generating plant, two drill presses, a bench grinder, an air compressor and a battery charger. Miniature lighting systems are installed. A burned up "black out" is accomplished by throwing the main switch.

Having had traveling technicians watching the performance of its *Flying Fortresses* since the early days of World War II.

Douglas maintains crews of these ex-

Maintenance

pert trouble shooters in numerous war-fronts. Lockheed likewise has its technicians in many parts of the world, and there are also scattered about numerous strategic points the factory trained men from Curtiss, Bell, Martin, North American, and Consolidated.

Civilians Replacing Enlisted Men at Military Sub-Depots

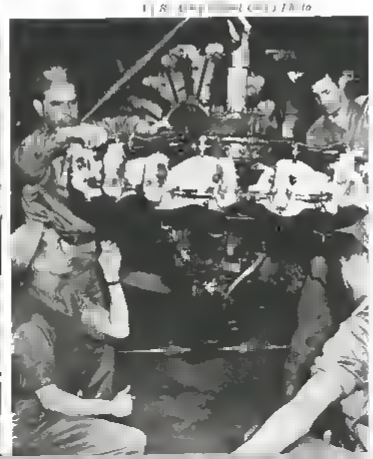
Maintenance personnel at the Luke Field Sub Depot, Arizona, is rapidly being civilianized so that experienced mechanics can be released for duty at operational centers. To the greatest possible extent, civilian personnel will be women employees in order to further assist the national manpower program.

At the well-organized Luke Depot, which performs everything in the line of maintenance up to major overhaul, women are being trained for the jobs in which they are best adapted, including instrument repair, work with fabrics, woods, and even sheet metal. Minor engine repairs involving the less strenuous phases may also be handled by the women employees.

Male engineers will always be necessary for the heavy maintenance and supply work due to physical requirements and also in certain administrative requirements. Officer personnel in limited numbers will be required to insure that the military mission is effectively carried out and kept up to date with changing requirements.

LEFT: Wallace G. Heacock, Assistant Supt. of the Luke Field Sub-Depot, shows Miss Elizabeth Kirby how to change spark plugs in an AT-6A advanced trainer. Miss Kirby is wearing the uniform which may be standardized for women employees of the depot . . . RIGHT: Civilian mechanics at Luke Field preparing a new engine for installation at the Luke Field Sub-Depot. The uniforms are not military and are especially selected to meet climatic conditions in Arizona.







Army Airacobra on a Fighting Front

HE'S BETTING *PLENTY* "on the Nose"



Sent "upstairs" to destroy an enemy attack, this flyer is placing his bets "on the nose" of his Army Airacobra.

For firing through the nose of his sleek and speedy fighter is a mighty cannon. A single shot, struck home, will blast the biggest bomber from the sky.

When plans were laid to build this "flying cannon" no gun so large had yet been mounted in a single engine plane. And Bell Aircraft, too, did its betting "on the nose." We set a cannon out in front then built a fighter plane around it. It was a new and untried theory that called for pioneering skill and engineering genius.

Theorists said it wouldn't work—scoffed at the thought—while a staff of able aircraft engineers, assisted by our Army Air Force, set out to do the job.

Our answer is the Airacobra—the only single-engine fighter of its kind. With engine "aft" the pilot sits behind his cannon, as though he rode the breech, so deadly accurate is his aim. With all at stake he's betting plenty "on the nose." © Bell Aircraft Corporation, Buffalo, New York

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1932 • The first Curtiss plane designed specifically as a fight-orbomber — a single seater, it was used by the U. S. Navy for operation from aircraft carrier



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1938 • The Hawk 75 — a monoplane fighter-bomber, incorporating heavier defense armament, increased maneuverability and carried a greater bomb load



1940 • Curtiss P-40 Tomahawk — equipped the R. A. F. in the Middle East and the American Volunteer Group in China, Java and Burma

HOW MUCH PASSENGER TRAFFIC?

In estimating future growth of domestic air traffic, some interesting criteria can be established by reviewing growth characteristics of other forms of transportation.

By EDGAR A. VAN DEUSEN

TO PREDICT TREMENDOUS growth for private and commercial flying in the United States over the next ten decades seems like betting on a "sure thing," but to venture a quantitative forecast of this growth might seem to be rank speculation. Nevertheless, a quantitative estimate of the expansion that a growing industry may reasonably expect to achieve can serve a useful purpose.

Several growth predictions of a general nature have been offered from time to time by leading representatives of aviation. For instance, Robert H. Hinckley in 1940 said: "Our federal airways experts estimate a volume of air traffic by 1945 that will be from 20 to 30 times what it is to-day," while W. A. Patterson, president of United Air Lines, shortly thereafter said that the air transport industry had reached only 15 percent of its potential markets.

These two estimates are not in statistical agreement, but although Mr. Hinckley's figures pertain to all classes of civilian flying, while Mr. Patterson's refer only to common carrier flying. Both predictions, it should be noted, were made prior to Pearl Harbor and before it was fully realized that the United States was to participate directly in the war.

In this study, which confines itself to passenger travel on common carrier airlines, there has been developed a "curve of expectancy"—which is offered with some reserve—but which attempts to forecast the long-term growth of revenue passengers and revenue passenger-miles, year by year, until the assumed saturation level has been reached. Airline travel within the United States only has been considered, and no attempt has been made to estimate express, freight and mail expansion. Since the curve describes a mathematical series it is a smooth trend line and ignores all cyclical and short-term distortions and such disturbing influences as the present war.

The experience curve of air transport thus far is too short to serve as a trend indication, or as a reliable base from which to project future growth. The 536 percent increase of 1940 passenger traffic over 1939, for example, if used as an index of future expansion, quickly leads to improbable results. For if it were assumed that revenue passenger miles would continue to increase at this annual percentage rate, they would expand to 8,801,8 00,000 by 1945 a volume that exceeds Pullman's 1940 revenue passenger miles of 8,314,000,000. By 1948 they would have expanded to 78,148,880,000 or 5.3 times Pullman's peak of 14,417,400,000 in 1920.

Over the six-year period 1936 to 1941, the airlines average annual rate of increase has been 31.4 percent. This rate projected leads to less improbable results, viz., approximately 4,100,000,000 revenue passenger miles by 1945, or 50 percent of Pullman's 1941 volume. But when extended to 1950 the result again seems unlikely, being 16,000,000,000 or 11.5 percent above the 1920 Pullman peak.

Unfortunately there is comparatively little "past" to common carrier air transportation, therefore, rather than attempting to project growth from airline statistics of the last ten years it has seemed preferable to review the growth history of other forms of transportation in the United States. Before doing so, however, it may be well to consider briefly the general phenomenon of growth.

The Phenomenon of Growth

Biologists have long observed that the quantity-time curve (frequently called the growth curve) of organic life, as manifested in plants and animals, follows a definite and characteristic pattern. Experience also indicates that organic growth as manifested in economic activity tends to chart a similarly characteristic trend curve, though the experience curve—which reflects cyclical and short term influences—will show wide and irregular divergences from the mathematical curve.

A number of mathematical equations of growth curves have been developed, one of the most useful and satisfactory of which is the logistic curve originated by the Belgian mathematician Verhulst. This was later modified into the so-called Pearl-Reed curve by Raymond Pearl and L. J. Reed of John Hopkins and adapted by them to human and population studies. There appears to be no sound reason why it is not equally applicable to commercial studies.

The equation of the logistic curve as used in this study is:

$$Y_c = \frac{k}{1 + e^{-bx}}$$

in which Y_c = computed values on Y axis

x = time intervals on X axis (years)

e = Napierian base

k = upper limit of values

The curve passes through three equidistant selected points, one near the beginning, one at the middle and one near the end of the period covered, designated y_0, y_1 and y_2. Three "expectancy curves" are presented, as discussed later, viz. A, B and C. The value of y_1 is the average number of passengers carried annually during the ten year period 1925-1935. y_2 is a value near the assumed upper limit and y_0 is the middle value in the point of contraflexure.

The curve and its equation, therefore, is an original formula for the prediction of future growth, but a mathematical trend line over a period of years predicated on an assumed peak to be approximated at an assumed time.

Economic Production

Bassett-Jones states that economic production in the United States follows one of three general trends, depending



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The Black & Decker Holgun is the most widely used electric tool in the aircraft industry. Light, compact, with "Pistol Grip and Trigger Switch" the Holgun ¼" Drill is designed for use in tight places, won't heat up under extreme service. Holgun comes in torques and spindle speeds for production drilling in all types of aircraft materials —in parts, sub-assemblies and assemblies—in armaments, vital instruments and equipment.

The Holgun (pictured above) is just one of many Black & Decker Portable Electric Tools used to speed aircraft production, maintenance and repairs. A few more are pictured on this page. For sound advice on any tooling problem you may have, and as a convenient, dependable source of supply, phone your nearby Black & Decker Distributor. Or write to The Black & Decker Mfg. Co., 738 Pennsylvania Ave., Towson, Maryland.

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upon certain basic differences as follows

1 Production based on exhaustible raw materials, such as coal, iron, copper oil, etc

2 Production based on renewable raw materials, such as agriculture, water power, etc.

3 Mixed types of production, such as various examples of manufactured goods and services

The ideal curve for each of these three types is indicated in Fig 1 In Type I it is obvious that eventually all reserves must be exhausted and production decline to zero, as for example, copper and tin mining in England

In Type II it is equally plain that an upper asymptote, or saturation level, must be approached, beyond which no further expansion can be expected

In Type III saturation level is followed by a period of decline occasioned by competition, new inventions etc. until a lower asymptote or new level of stability is gained.

The law of organic growth as exemplified in economic activity appears to comprise four or five main and successive periods substantially as follows

Period 1 Experimental and introductory period, during which the public is being educated to accept the new idea

Period 2 Rapid growth period till acceptance by the public—the new goods or services become an integral part of social and economic life.

Period 3 Retardation period, growth slows down as saturation level is gradually approached

Period 4 Saturation or maturity period.

A fifth period follows in Type III industries, viz, a period of negative growth or decline Railroad passenger transportation is an example of this type

Population and Railroad Travel

This study deals with transportation rather than with the production of raw materials or fabricated goods but the same basic laws would appear to apply and in the curves presented marked similarity to the ideal or theoretical growth curves will be noted

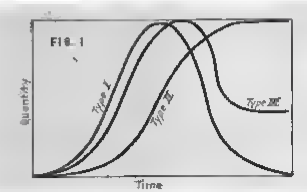
Since all economic activity depends on population, Fig 2 is given in order to show the growth of population in the United States The projection from 1940 to 2000 is based on estimates by the Scripps Foundation for Research in Population Problems It will be observed how closely it follows the pattern of a Type II curve shown in Fig 1

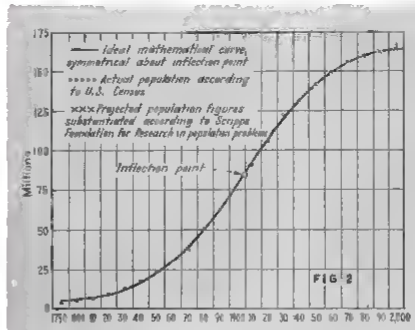
In 1830 the population was 12,866,-020 and railroad mileage was 13 by 1840 population had grown to 17,069,453 and railroad mileage to 2,818 From that point on mileage increased steadily,

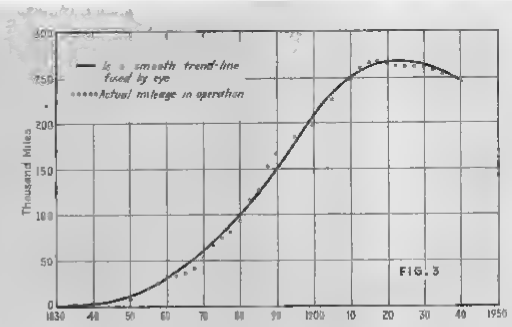
Air Transport

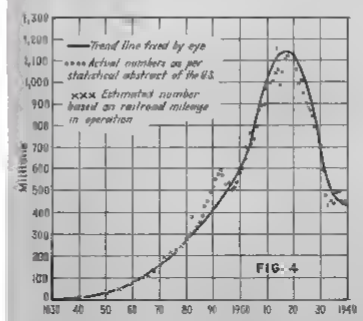
keeping pace with ever growing population and territorial expansion as indicated in Fig 3 Maximum growth of mileage occurred in the decade 1880-1890 after which growth slowed down as the saturation level was approached and eventually the 1916 peak reached Since 1920 total mileage has declined as unprofitable branch lines have been abandoned in response to competition of the automobile and improved highways

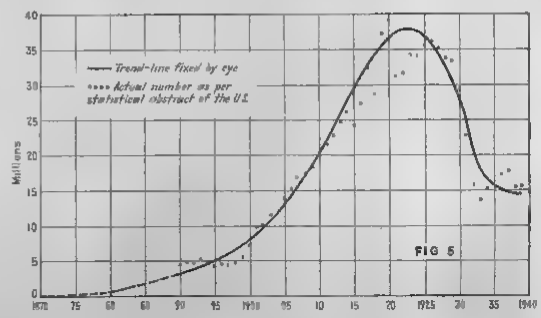
Despite frequent accidents which were sometimes accompanied by appalling











[illegible] the number of passengers [illegible] year expanded far ahead of the rate of increase of truck miles and population. The period of maximum growth appears to have been between the years 1880 and 1910. The peak was reached in 1920, since when rail passenger travel has declined rapidly and now seems to be seeking a new and lower stability level, though it is by no means clear that the declining trend has terminated. The curve, as illustrated in Fig. 4 can be classified as Type III though it is much distorted by cyclical and other influences.

In 1860, when the population was about 31,000,000 and railroad mileage about 30,350, Pullman's Palace Car Company was organized to provide sleeping accommodations for rail travelers and a degree of travel comfort not afforded by the usual day coaches. Its appeal was however, to the wealthier class of traveler. Growth was slow in the earlier years, but rapid from 1900 up to the 1920 peak, after which a progressive decline set in. The entire experience, as shown in Fig. 5 thus described a curve of Type III characteristics. It should also be noted that this "luxury" class of travel is especially vulnerable during cyclical depressions.

With the advent of the automobile about 1900 a new and significant factor was introduced into the transport situation though unappreciated at that time and for many years thereafter. Registrations of passenger automobiles were about 8,000 in the year 1900; in ten years annual registrations had risen to 458,000, and in 1913 they passed the million mark. When these annual figures are plotted, as in Fig. 6, they describe approximately a Type II curve except for the distortion occasioned by the collapse and depression which followed 1929. Ultimately, as fixing mileages, it may well change into a Type III curve.

By examining carefully these three curves on the composite Fig. 7, the year in which the automobile dealt its decisive blow to the railroads can be readily detected. It will be seen that 1920 was the peak year of both Pullman and railway passenger travel, and that automobile registrations had already entered their period of maximum growth. Railroad miles had passed their peak.

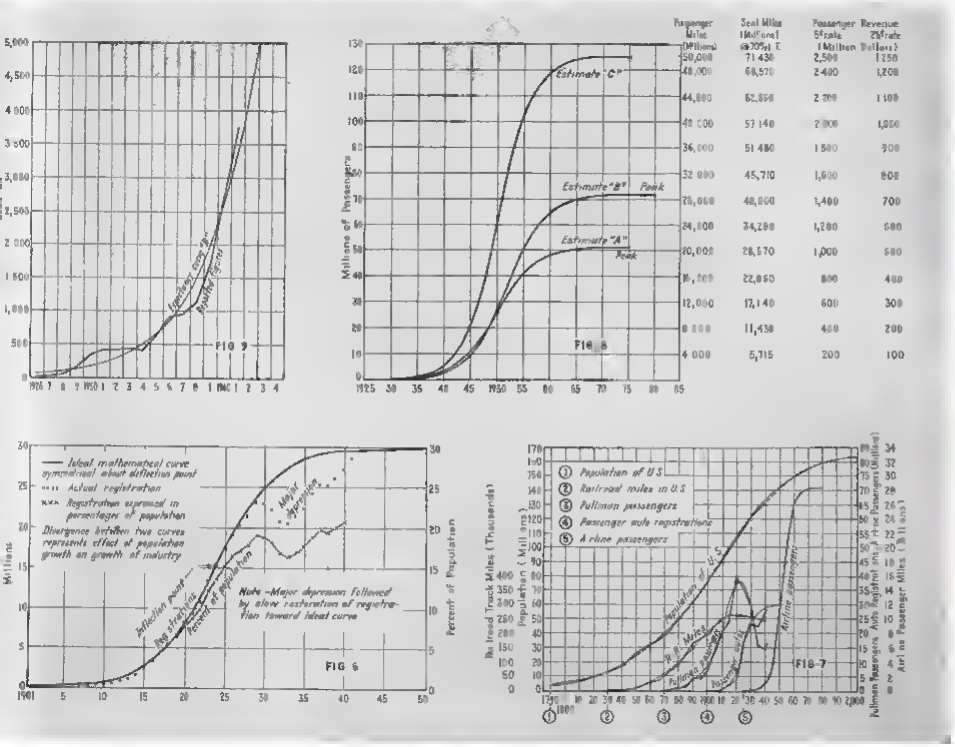
A Basis for Estimating

Reasoning from the facts and figures which underlie these six charts, it becomes possible to make a perhaps not unreasonable estimate of the saturation level of urban passenger travel, both as to time and quantity.

In this connection it is pertinent to bear in mind that the railroads experienced their long period of growth (about 60 years) mainly throughout an era of heavy immigration and rapid population growth and of territorial expansion beyond frontier after frontier. Automobile travel, on the other hand, developed during a time when population growth had started to slow down, when the country was relatively mature and the last geographical frontier had been crossed. Nevertheless, if we assume it to have reached its approximate peak, its growth has been more rapid, covering a period of only about 40 years. It is important, however, to note this significant difference: that the automobile provides individual and family transportation rather than mass transportation.

Bearing in mind these general facts it is now of interest to examine the following figures and charts.

(*Turn to page 282*)



EYES, EARS AND A STRONG ARM —FOR THE NAVY!

DESTINED TO SEEK OUT AND STRIKE DOWN the enemy on the seven seas, new Ryon-built Novy SOR-1 warplanes will soon be rolling off our assembly lines in volume to join the growing armadas of the U.S. and United Nations.

TWENTY YEARS OF RYAN "KNOW HOW" insures both quantity and quality production of these formidable planes, built to better perform one of the biggest jobs at hand—scouting the seas to provide air protection and striking power against Axis submarines and war ships. All-out production of these Navy aircraft is but one of many Ryan assignments for victory.

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Adopted — for their ruggedness and high performance — as standard equipment of the Army Primary Training Planes, SENSENICH Propellers are being rapidly absorbed by the Military Services.

But,— SENSENICH also has an obligation to the Trade which has been demanding SENSENICH Propellers in ever-increasing quantities.

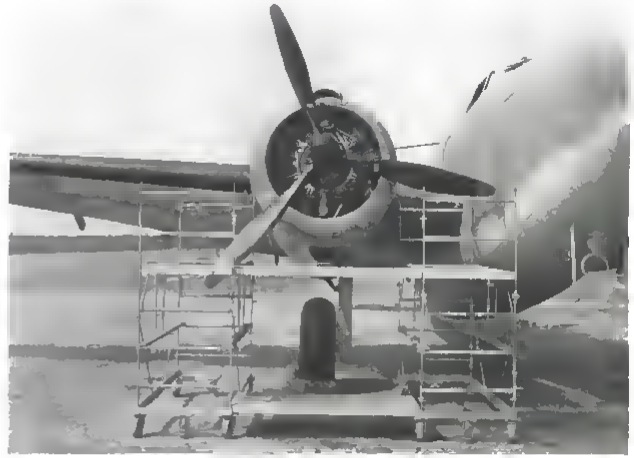
SENSENICH is sparing no effort to meet the Commercial requirements as rapidly as its possible without interruption of its War program.

SENSENICH BROTHERS

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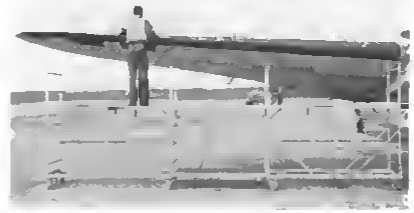
LITITZ, PENNSYLVANIA, U. S. A. CABLES: SENSNIK

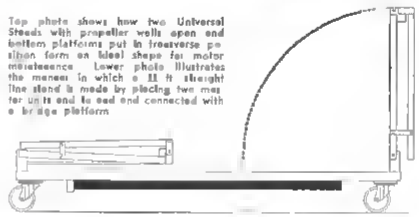
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•
STRONG
•
VERSATILE



UNIVERSAL *Repair Stand*

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Top photo shows how two Universal Stands with propeller wells open and bottom platforms put in transverse position form an ideal shape for motor maintenance. Lower photo illustrates the manner in which a 11 ft straight line stand is made by placing two master units end to end and connected with a bridge platform

Without the use of a single tool the stand is quickly folded into a package that measures only 1 5 x 1 0 x 7 0 with an loose parts. Stands easily under wings, takes up little hanger space and can be shipped *without boxing* in truck, train or transport.

Designed not just for one job on one particular plane but as a multi-purpose working platform adjustable to the shapes and heights required for many jobs on many planes.

Each master unit, measuring 2'6" wide by 7' long can be "opened up" to form a platform 8'6" long at any heights from 3'6" to 6'6". A flip of the hinged cover in center of stand provides an adequate propeller well. . . . Arrangement of two or more Universal Stands permits an "H", "L", "T" or "Z" shape or a hollow rectangular platform—combinations that cover every phase of "high reach" aircraft maintenance.

While in use these light, versatile stands are held absolutely rigid and motionless by means of Bassick Truck Locks: The job over, a slight push sends them rolling to the next operation on sparkless *plastic* wheeled casters.

Prior to March 1942, W & M Universal Stands were all "special jobs", but their success in both civil and military service has prompted us to establish quantity production. . . . Glad to send you further details and quote prices and delivery dates. Write or wire today.

THE WOLFE & MANN MFG. CO.

AIRCRAFT EQUIPMENT DIVISION

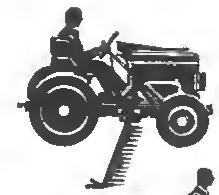
28th. & SISSON STS., BALTIMORE, MD.

WORTHINGTON
AIRFIELD
"GRASS BLITZER"

Largest Capacity Turf Cutting Apparatus Yet Developed —Keeps Airfields in Condition to "Keep 'em Flying!"

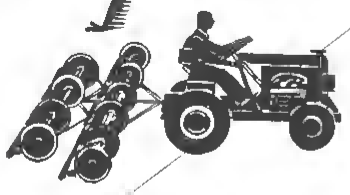
Experts advise that **at least 10-15 cuttings** a season (depending upon location and weather) are required for development of the best turf conditions, which is important, because thick, dense turf:

1. Keeps down dust which is a cause of too frequent plane motor tear downs and parts replacements (Originally 25% — now 65% est.)
2. Helps eliminate hazards of loose stone, aggregate, gravel, etc., injuring propellers during motor revups, take offs and landings
3. Absorbs rainfall, preventing muddy areas and the danger of serious skids.
4. Helps eliminate wheel marks which can be photographed from as high as 30,000 feet (An important consideration for tactical bases.)

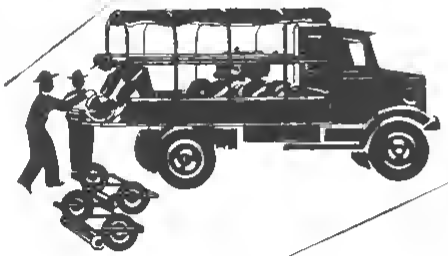


"GRASS BLITZER" CAPACITIES COMPARED

The farm-type tractor and 7-foot sickle bar at maximum speed average approximately 3½ acres an hour or have a capacity of approximately 28 acres per 8 hour day. (Practical operating capacity 15 acres per 8 hours.)



The lawn, or golf course type gang mowers, because of their construction, cannot be hauled at practical speeds exceeding 6 miles per hour under Airfield conditions. The 7 gang size at this speed has a capacity of only 11 acres per hour or 88 acres per 8-hour day. (Practical operating capacity 50/55 acres per 8 hours.)



Maintaining mowing schedules on widely scattered Dispersion Fields may not always be possible or practical by depending upon Army Trucks when and where needed! Man power, not always available at Main Base and at Dispersion Field, is needed to load and unload equipment.

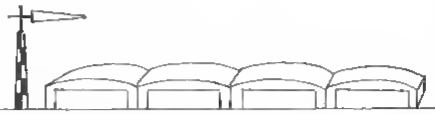
With millions of acres of turf in new Airfields to be cut regularly, a new problem presented itself, not only to Worthington Engineers but to new Officers in charge of these large areas. **Speed, plus economy of gasoline and man-power,** was the answer sought! And that answer is the new Worthington Airfield "Grass Blitzer."

More than a year ago the Worthington Mower Company, for 30 years specialists in mowing and turf maintenance, applied its knowledge and experience to the development of this large capacity unit — a fast Tractor and new combination of Gang Mowers. Comparative and conservative figures show its grass cutting capacity to be four times greater than that of any other combination of grass cutting equipment under Airfield conditions.

"Grass Blitzer" is the name we have given this new grass cutting apparatus, but it's more than just a machine — it's a **principle,** a method, and involves a system of mowing Airfields which accomplishes the desired results for turf development at the most practical, efficient and economical cost. It is a new problem — it will be with us for years. We must take into consideration not one cutting — but 10 to 15 cuttings per acre per year and not alone the acreage on one individual Airfield but our Government's complete problem involving millions of acres. Every dollar that is saved in initial equipment cost—every man-hour that is saved—every gallon of gasoline saved—by the Worthington "Grass Blitzer" machine and grass cutting method for Airfields — contributes that much more to our War effort and Victory!

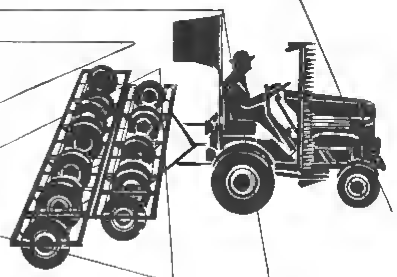
It is only natural that Worthington — first to develop the "gang mower" principle — the triple, five and seven-gang mowers to solve 'peace time' mowing problems, should be first to study the military problem of Airfield turf cutting and first to produce equipment that does the job efficiently, economically and fast.

The tremendous capacity of the "Grass Blitzer" is made possible by an entirely new type of gang mower. Castors and rollers (ground contacts) have been eliminated — only large traction wheels touch the ground and the height of cut is established by suspension from the frame instead of from the ground up. This enables the fast (powered by Chrysler) Worthington tractor to haul a 9-gang, cutting 21½ feet, at 20 miles per hour, cutting 46 acres per hour, or 368 acres per 8 hour day. (Practical operating speeds at each Airfield depend upon finish surface grading.)



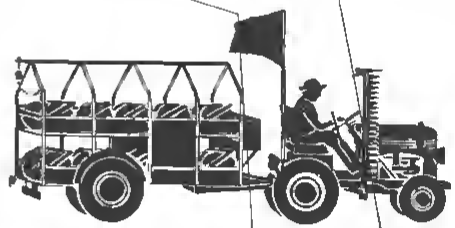
WITH OTHER MOWING METHODS:

The new Worthington Airfield "Grass Blitzer" is capable of operating at speeds in excess of 20 miles per hour! The 9 gang has a cutting swath of 21 feet 2 inches and at 20 miles per hour has a capacity of 46 acres per hour, or 368 acres per 8-hour day.



The Worthington "Grass Blitzer" Dispersion Field Transport Trailer is attached to the tractor element and hauled by the operator over public roads from one field to another at speeds in excess of 30 miles per hour. This "one man" mobility of the "Grass Blitzer" outfit, and its high grass-cutting capacity, make it possible to study the possibilities of grouping acreage within a given radius to be serviced by one "Grass Blitzer" outfit from Main Base Fields.

The "Grass Blitzer" gang is disassembled and loaded, or unloaded and completely assembled in less than one-half hour by one man. Gas and oil are not always available at Dispersion Fields — the Worthington Transport Trailer provides 5 five gallon gasoline cans and 1 five-gallon oil can to solve this problem.



WORTHINGTON MOWER COMPANY

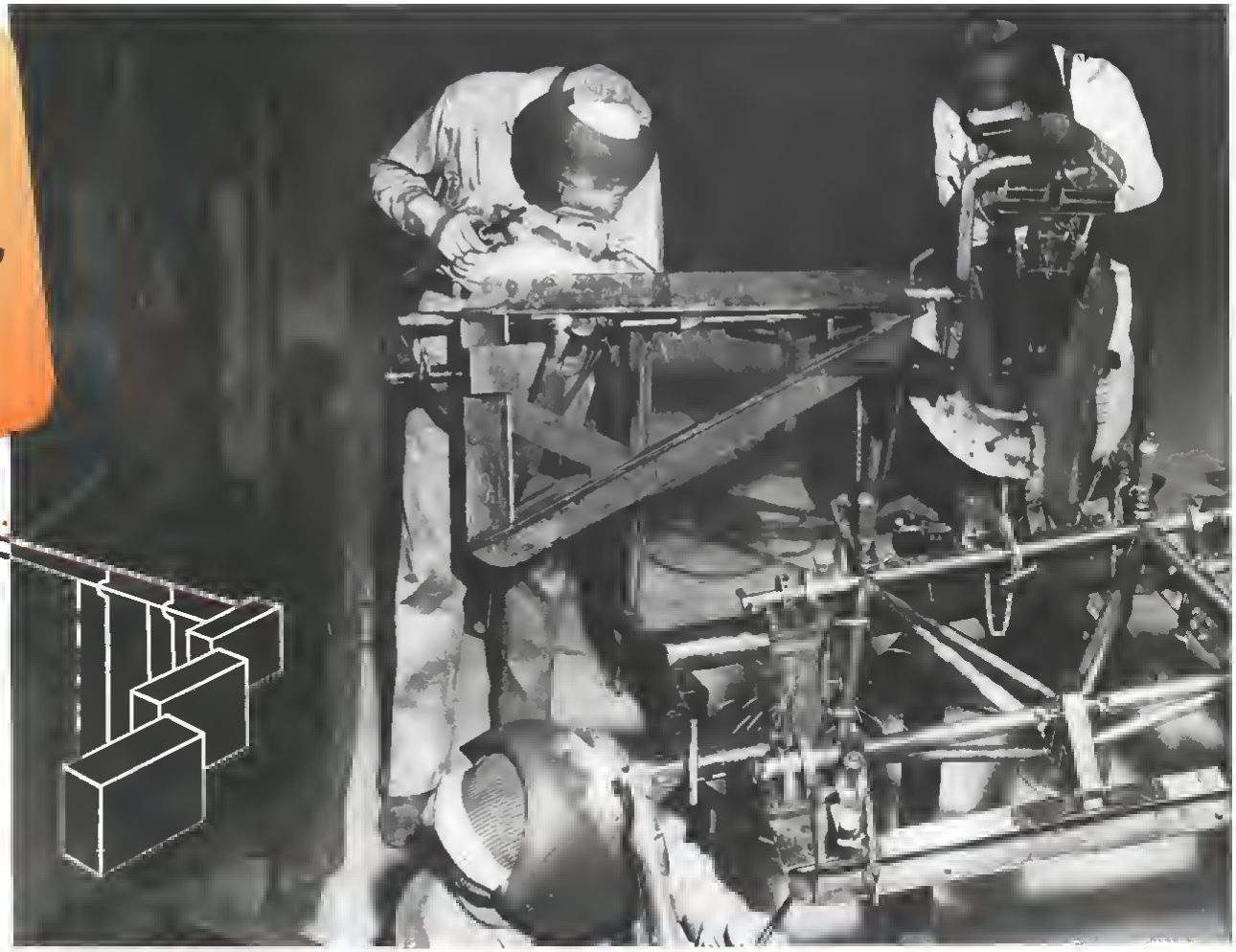
STROUDSBURG, PENNSYLVANIA

FOR FAST, UNINTERRUPTED PRODUCTION

... weld with a

WILSON "HORNET"





...AND NOW COMING OFF THE PRODUCTION LINE THE "HONEY BEE" ARC CONTROL STATION

Specially developed for welding light gauge metal in the aircraft industry. It's three outstanding advantages:

1. More arcs per machine.
2. Gradual current reduction for remote crater control.
3. Remote control of all operations.

Do not fail to see our "Helicoil" advertisement in the November issue of this magazine or write to Wilson Welder and Metals Co., Inc., 60 East 42nd St., New York, N. Y.

WILSON WELDER AND METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.

FOR ALL-POSITION WELDING OF THIN METAL AND LIGHT SECTIONS

Ideal for the aircraft industry is Wilson 520. With it, a smooth welding bead invariably results. Has excellent operating characteristics when used for a c or d c welding. Spatter loss is exceedingly low



CP SMALL TOOLS SPEED UP CLOSE-QUARTER WORK



DRILLS, SCREW DRIVERS, WRENCHES DESIGNED FOR SPECIFIC JOBS

Small, Light, Easily Handled by Women

NEW YORK (CP)—The speed with which CP Pneumatic Drills, Aero Riveters, Wrenches and Screw Drivers carry out their work—even in the closest quarters—has won them wide use in the aviation industry. Light, compact, small in diameter, easily gripped, and permitting continuous use without fatigue, they are ideally suited for use by women workers.

Write for data on the world's largest line of Aviation Tools.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices 6 E 44th St., New York, N. Y.

↑ **COMPACT, HAND SIZE,** but amply powered for fast 1/8" to 3/16" drilling in light metals, CP No 301 Pneumatic Drill is available in a wide range of sizes and speeds, with various types of heads and handles.

↓ **TIGHT RIVETS** in tight places—the CP-3X Aero Riveting Hammer with angle attachment—the only airplane riveter with attachment for riveting in hard-to-get-at places.







↑ **FAST, LIGHT, EFFICIENT** CP No. 301 Pneumatic Screw Drivers speed up screw driving, 45° and 90° angle models for the hard to-get-at places.

← **FAST NUT RUNNING** in close quarters is easy with CP-337-RAF Pneumatic Wrench (impact type) with 45° angle head. Note how easily girl reaches these ¼" nuts despite the horizontal member.

CHICAGO PNEUMATIC

AVIATION TOOLS

ALSO: Air Compressors, Electric Tools, Hydraulic Aviation Accessories, Diesel Engines, Rock Drills

RIVETERS
RECIPROCATING COMPRESSION
HYDRAULIC
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GRINDERS
SCREW DRIVERS
NUT RUNNERS
PLANISHING IRONS



"ALL CLEAR"

When the "All Clear" of final victory sounds, Jefferson-Travis will again make available its two-way radio communication equipment for private and commercial use throughout the world. But until then we will concentrate all of our effort and energy in the continued production of equipment for the armed forces of the United Nations.

JEFFERSON-TRAVIS RADIO MFG. CORP.

Manufacturers of Aircraft, Marine and Mobile Radio Communication Equipment

NEW YORK N Y WASHINGTON, D. C.

GENERAL CONTROLS

AIRCRAFT TYPE

ELECTRIC VALVES

hi-g Trade Mark. Most important operating characteristic of General Controls Aircraft Type Electric Valves is their positive ability to operate in any position, regardless of vibration, change of motion or acceleration.



OIL OR GASOLINE SAFETY SHUT-OFF

(TYPE AV-12 AT LEFT)

These valves are of the packless, area-balanced or single-seated, metal-seated type. Available normally open or normally closed, requiring current only to close or open. No integral control switches. Avoid vapor lock. For intermittent duty only. Operate on D.C.—from 6 to 24 volts. Handle oil and gasoline.

FUEL CONTROL TO CABIN HEATERS

(TYPE AV-1 AT RIGHT)



These valves are of the single-seated, metal-seated two-way, current failure type. Weigh from less than ½ lb up. Handle all vapors, vapor mixes, liquids and gases. Operate on D.C. Available for continuous or intermittent duty. Operation unaffected by vibration, mounting position or acceleration.



NEW BULLETIN. Illustrates and describes complete General Controls AV Series which include valves for engine priming, gasoline cross feed, oil dilution, fuel and anti-icing fluid control, also high pressure 3 way and 4 way selector valves. Request copy.

GENERAL CONTROLS

PIONEERS AND LEADERS IN THE DEVELOPMENT AND MANUFACTURE OF MAGNETIC VALVES

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Send these INTERCEPTORS *against Delays and Errors in Production*

On production machines and processes, Veeder-Root Counting Devices keep up a running hire of facts-in figures that help to fight off the attacks of waste, delays and all the countless errors that grow out of guesswork and uncertainty. For your production men can see, in plain black and white, from moment to moment, exactly where each machine stands in relation to total production. So they can see any need for adjustment or change of control. There are Veeder-Root Devices for mechanical and electrical operation on every type of machine—to count in any terms or units of performance. Quick and easy to install without disturbing production routine. Learn how *you* can count on Veeder-Root. Write.



Medium Size Reset Counters for counting strokes or revolutions. 2 to 8 figure wheels. May be furnished with total reset and lock key if desired—also with electric control arrangement.

VEEDER-ROOT

Counting and Computing Devices

Proper Staking Important

Restrictions on civilian flying imposed along both coasts have brought a sharp increase in wind accidents to ships tied down out doors in areas where flying is still permitted, according to a report of Aero Insurance Underwriters.

Such accidents already have damaged some planes beyond repair and in others the shortage of parts and materials has kept planes and pilots grounded, they say.

While there are several satisfactory methods of staking ships down the important thing, it is pointed out, is to keep a careful and constant check on the method used to see that changes have not loosened ropes and stakes or shifted the anchors.

In many cases where wood stakes have been used, rain has swollen them enough to enlarge the holes in the ground so that when the ground later dries out, the stakes have been left loose. Cement blocks with ring attachments set flush with the ground surface are said to be the safest equipment. Next best bet is said to be to bury lugs with ring attachments.

In tethering a plane, good strong rope should be used—keeping in mind that today's rope may not be as strong as pre-war material—allowing plenty of freedom for it to stretch and shrink with the weather. The tail should be securely anchored to a metal pin, but care should be taken to see that too much play is not given as it might be whipped back and forth with ensuing damage to the tail surfaces.



FLYING MINUTE MEN

Typical of the services being rendered by Civil Air Patrol is this scene made somewhere in New Jersey. Two CAP pilots load an Aeronca with munitions samples just before taking off for an Army proving ground where the samples will receive a thorough going over. Immediately after heat treating at a nearby plant the samples still hot are rushed to the airport where they go aboard the planes for the flight to the proving ground and prompt firing.

Solomon Heads Training Unit

S. J. Solomon, president of Northeast Airlines, Inc., has been named to head a coordinated training program by which the domestic airlines will attempt to keep themselves supplied with both flying and ground personnel necessary for their vastly expanded special services for the Army.

The new organization will be known as "Air Line War Training," and will be charged with obtaining pilots, navigators, radio operators, mechanics and others essential to operation of the world-girdling airlines already in service and due to be greatly expanded.

Headquarters will be maintained in the American Security Bldg., Washington, D. C.

ON PATROL . . .

• CAP courier service continues to expand. Pennsylvania's Wing—old hands at the business now—has inaugurated another service at York, where five planes and pilots are on duty, available for all the city's wide range of war industries. This service has already proved it exceptional value since York has no regular airline connections. The Second Courier Command has been organized at Buffalo, N. Y., and another is being set up at Syracuse. The most spectacular civilian defense demonstration yet staged recently broke in Birmingham, Ala., when 50 CAP planes ranged out on the city to drop more than 8,000 "bombs"—bags of sawdust tagged with red and yellow streamers to mark them as murderous high explosives.

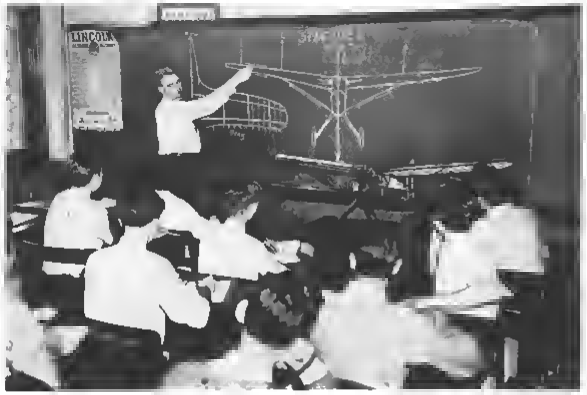
Enlistment applications received by National Headquarters have passed the 58,000 mark and still pour in at a rate fast enough to keep most units up to operational strength despite the fact that many men are being lost to the services in other wartime assignments.

In cooperation with the Navy League, Kentucky Wing is staging a series of eight Sunday mobilizations throughout the state to bring out crowds



FOR BETTER MAINTENANCE

Army Air Forces mechanics receiving training at the Boeing School division of United Air Lines, on parade as the school is awarded a special merit pennant for outstanding service. The Boeing school has been training mechanics for the AAF since 1940, the facilities having been increased several times since the program was inaugurated. In making the specially created award to T. Lee, director of the school, Maj. Gen. John F. Curry said that in times like these when every effort must be bent toward winning the war, it is particularly gratifying to those in command to find the schools doubling their efforts toward fulfilling their tasks.



EMBRYO PILOTS

The why and how of flying is explained to Air Training Corps of America members in aerodynamics class at Albert Leonard High School New Rochelle, N Y Under th program ATCA plans to give pre-flight training to two million 15 to 18 year olds by 1944 covering such subjects as aerodynamics meteorology navigation and communications. In addition the members undergo rigorous physical training to toughen them up to standards set by Army and Navy Air Forces.

for Navy recruiting The first such show brought out 91 of the Wing's available 97 planes; more recruits were signed up on the one day than for several weeks previous . . . For the third time New York CAP has had a plane donated This one came from the Penny-A-Plane Club, organized in Middletown for one purpose—to collect enough pennies to buy the plane The first plane donated was given by Group Commander John Wright who had some training he wanted to do but no plane with which to do it When some of his fellow citizens of Jamestown heard of it by round about ways they started sending in donations with the result that there was not only money enough to buy another plane, but some left over for operating expenses . . . Latest addition to National Headquarters is First Lieut Richard S Wolfe, AAF

New Las Vegas Airport

Ground has been broken for a new airport, 5 mi south of Las Vegas, Nev, to be known as Alamo Airport The facilities will be open to the public

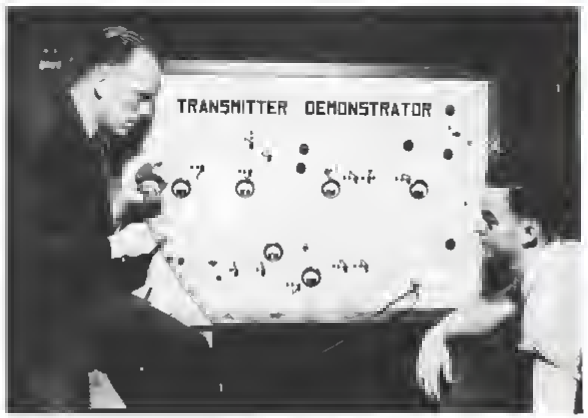
A complete government-approved flying school and aircraft repair station is being moved from the East and the operating company, Alamo Airways, will be managed by George Crockett, formerly with Stinson Aircraft Division of Vultee Aircraft, Inc Crockett reports that while the main purpose of the organization will be to train pilots for the Army and Navy, every effort will be made to develop facilities for the private pilot and the post-war flying tourist

Two hangars are to be constructed immediately, one to be used for flight training operations and the other to house privately owned planes.

Civil Operation and Training

ALONG THE APRON . . .

• University of Southern California has started first of five classes of 25 student pilots it will train annually under the CAA program Flight and ground training will be given at Baker, Calif, with flying portion of the courses assigned to Ralph Hemphill's United Flying Schools of America, Inc, at the Silver Lake Airport All students will be Army and Navy Reserve personnel enrolled at USC . . . Polaris Flight Academy's War Eagle Field at Lancaster, Calif, formerly used exclusively for training RAF cadets, has been taken over by the Army Air Forces as a civilian operated basic training school . . . Boeing School division of United Air Lines, which has been training AAF mechanics for the past two years in addition to its commercial ground school program, has converted 100 percent to military training; all commercial training has been suspended for the duration . . . Travel fellowships awarded by Pan American Airways in cooperation with the Institute of International Education have been awarded to 15 Latin Americans.



VISUAL TRAINING AID

This visual device for speeding training was developed at United Air Lines' Boeing School of Aeronautics to demonstrate transmitting principles and operation The schematic diagram shows the oscillator radio frequency amplifier and speech amplifier with plate modulation Each symbol on the circuit diagram represents the actual part mounted directly behind it on the opposite side of the panel Component parts are wired together as in the circuit diagram and perform exactly the same as in any radio transmitter.



". . . nor will this global storm deter our forward flight."

PUMP ENGINEERING SERVICE CORP—DIVISION OF BORG-WARNER—CLEVELAND, OHIO

now, and in the future—PESCO pump performance excels



WE'RE SHIPPING SILK BACK TO JAPAN!

☆ To bring Peace to this mad world, we are sending our Bombers over the "Land of the Rising Sun", manned by American boys protected by 'chutes made of silk.

Our entire production of parachutes is being devoted to the service of our Armed Forces. Before the war Switlik 'chutes were used by the majority of pilots in the United States, and we are preparing now to accommodate the requirements of a tremendously expanded aviation industry after the war.

How?

By constantly redesigning and improving our 'chutes; by incorporating more safeguards, finding better materials, developing better workmanship and lowering the cost. Our specifications are now, and always have been, more rigid and exacting than even those laid down by the watchful Civil Aeronautics Authority.

So, when the last battle has been won, you will find us prepared to meet the needs of America's new army of peace time pilots.

Faithfully,

President

FIVE REEL SOUND FILM 16MM.—"Parachutes for Safety" may be had for a one day showing by flying schools and colleges upon request. This unusual film describes the manufacture, packing, service, maintenance and use of parachutes. Write on letterhead to Switlik Parachute Company, Trenton, N. J.

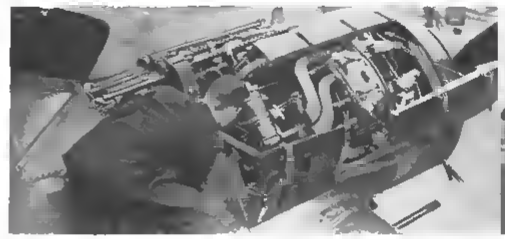
SWITLIK PARACHUTE COMPANY

AMERICA'S LARGEST MAKERS OF PARACHUTES

TRENTON, NEW JERSEY

FOCKE-WULF FW-190A3

International News Photo





RIGHT Flight tests of this Focke Wulf 190A3 captured intact by the British reveal many unusual design and construction features but show that 'the pride of the Luftwaffe' leaves much to be desired. Note the wide tread of the landing gear—12 ft.—made necessary by a landing speed of 110 mph. LEFT This close up of the Focke-Wulf 190 shows the extremely close cowling around the BMW 801D 14-cylinder engine, the first radial air-cooled engine to be mounted in a German fighter. Note the cowling louvres through which cylinder-cooling air and exhaust are dissipated. Note also the 20-mm cannon, set in the leading edge of the wing, fires through the propeller arc.

THE FW 190A3, newest and 'hottest' German fighter plane, is an extremely good craft, but it does not live up to the claims made for it by Nazi officialdom. In fact both British and American planes can, as has been proven in combat, more than hold their own against it.

Nevertheless, many points of interest and value to the designer, the production man and the maintenance chief have been brought out by inspection and flight tests of British engineers, whose reports have recently been made available. This close study was made possible when a German pilot was forced down in England and captured before he could destroy the plane.

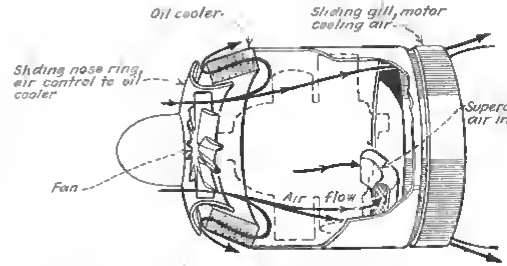
Created by Kurt Tank, builder of the Focke-Wulf *Condor*, long range four-engine bomber and the FW 189, short range reconnaissance plane, the 190 was designed for quantity production and extensive subcontracting.

It is a low-wing, full cantilever monoplane with a 34 ft 5-in. span and length of 29 ft 4 in. Wing construction is of conventional two spar type, with the wing being built in one piece. While this has effected a material saving in weight it has made maintenance more difficult. Wing trim tabs are small perforated plates on the ailerons and are adjustable only on the ground.

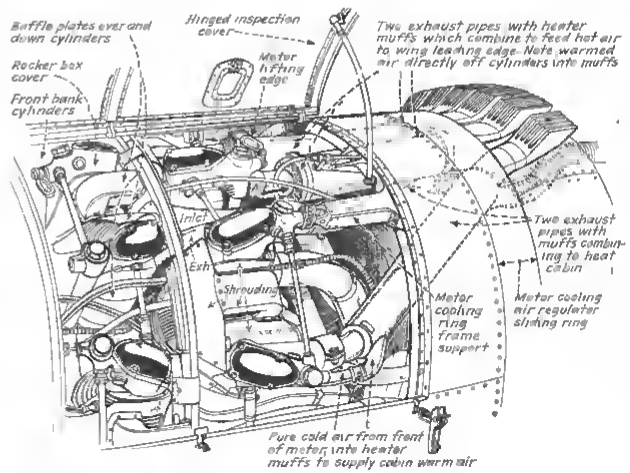
Split flaps are electrically controlled by push buttons to three positions, closed, down 10 deg. for takeoff, and down 60 deg. for landing.

Unlike modern Allied craft which

(*Turn to page 306*)



Cut-away and diagrammatic views of the BMW 801A engine forerunner of the model D installed in the Focke-Wulf 190 the main difference being that on the D the nose ring and motor cooling air regulator rings are not adjustable. These illustrations, redrawn from 'The Aeroplane,' show the large cooling fan installed just behind the propeller and point up the reverse flow of air.





. . . for security in flight

The widespread use of the TITEFLEX ignition harness goes deeper than mere availability. It stems from industry's recognition of the *dependability* inherent in this pioneer product... its *enduring tightness* under severe conditions of vibration, temperature and altitude . . the *lasting protection* it affords to vital ignition lines and radio communications.

It's the same *time-proved* dependability which has kept TITEFLEX the leader in flexible tubing for over a quarter of a century which is now providing an *added-measure* of security for men who fly. Titeflex Metal Hose Co., Newark, New Jersey.

Titeflex

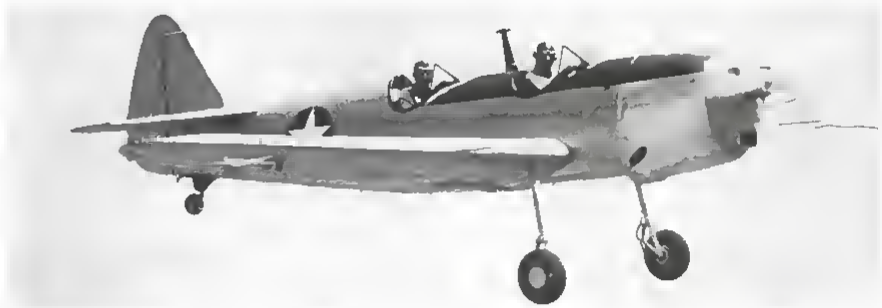
REG. U. S. PAT. OFF.

RADIO SHIELDED IGNITION HARNESSES

NEW RYAN PT-25

Flying Equipment

Plastic-bonded plywood military trainer designed for quantity production uses minimum of strategic metals



The Ryan PT-25 plastic-bonded plywood primary trainer developed for the Army Air Forces is said to be the nearest approach to elimination of strategic materials with less than 2 percent of its weight being aluminum. In addition to complete dual primary training equipment the plane is also fitted with night flying equipment for use in basic training.

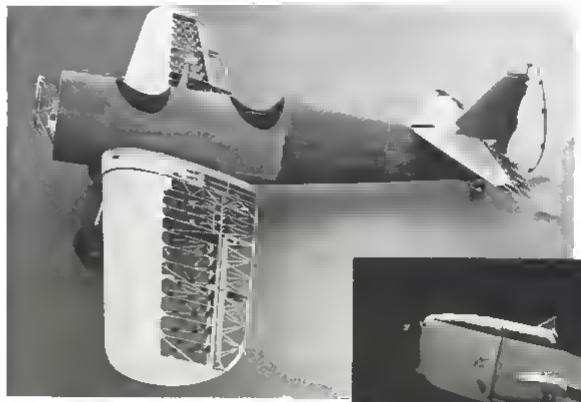
THE NEW TWO-PLACE Ryan primary trainer, designated PT-25 by the Army Air Forces, is believed to have reached the highest point yet achieved in elimination of strategic materials in military aircraft. The only aluminum or strategic materials in the craft are in the engine cowling, representing less than 2 percent of the total weight of the plane.

The plane has been designed to eliminate all possible compound curves, with the result that little special equipment is necessary for its construction. The only molded plywood section is the leading edge of the outer wing panel. Otherwise, standard flat sheets are used, facilitating application of cold setting formaldehyde glues.

The plywood covered fuselage is of monocoque construction, making use of ten bulkheads formed of laminated spruce. The main bulkhead, No. 3, is made in three parts, slotted in the lower half to receive the center-wing spar. The No. 2 bulkhead, which carries the torque tube that joins the leading edges of the outer wing panels, has black walnut insertions every other lamination. The No. 1 bulkhead has black walnut plates at the four engine mount points, and the engine mount fitting makes use of a split longeron to carry the engine load back through the fuselage.

Wings are full cantilever with monospar center section, having a two-to one taper ratio and 5 deg. dihedral. Different NACA airfoils are used at the root and tip. The two outer panels have removable tips to facilitate inspection, maintenance and repair. Each panel is

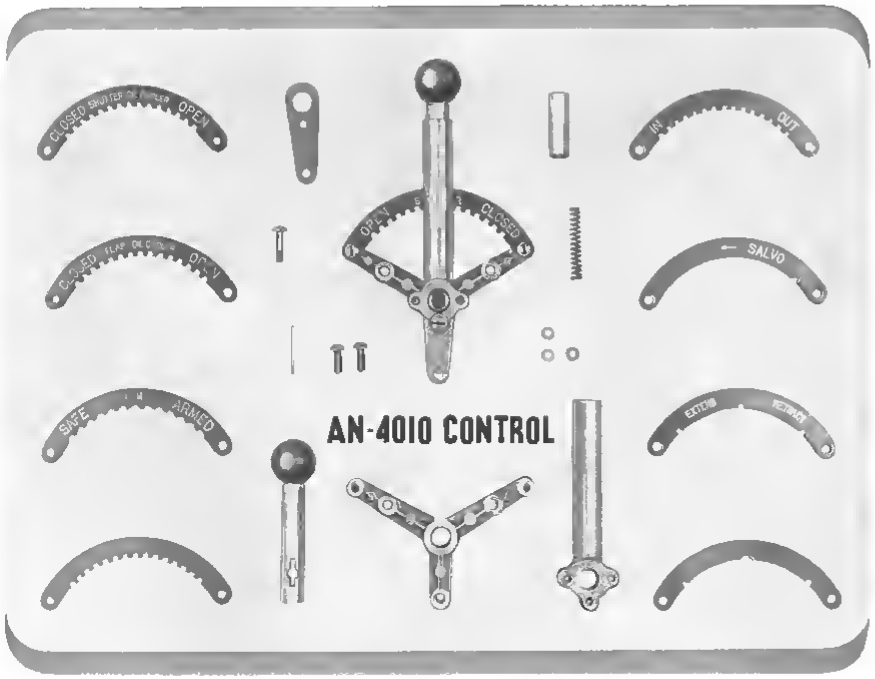
(*Turn to page 285*)



LEFT—The leading edge of the wing is the only molded plywood used on the new PT-25 with standard flat sheet being used elsewhere to facilitate quantity production . . BELOW—The PT-25 is a completely new design with full cantilever wing and tail surfaces and monocoque fuselage construction. The power plant is a 185 hp. six-cylinder Lycoming engine.



LET'S FACE A FEW FACTS ON AIRCRAFT PARTS

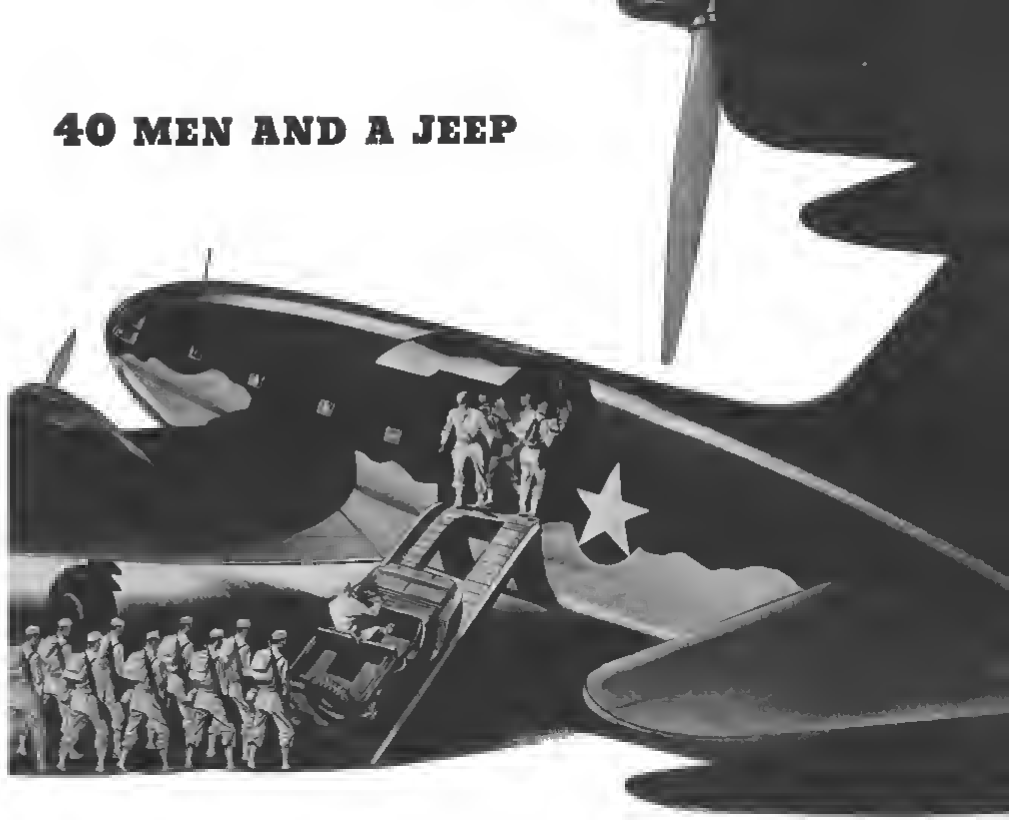


While our newly expanded production facilities are taxed to capacity, we are in a position to give prompt deliveries on the shutter controls illustrated. The AN 4010 assembly is in continuous production. Various adaptations are suitable for controlling flaps, bomb racks, tail wheel locks, landing gears, and other applications... On other items in our wide range of aircraft parts and accessories, we are frank in admitting that prompt deliveries are not possible. When we are forced to say "no," we'd like you to remember this: *Every man, machine, and ounce of material in our plant is in this fight, all the way*—turning out war products as fast as we know how. Rejects are remarkably low, and production efficiency is going up every day. Army and Navy specifications are rigidly enforced, right down to the last detail. On *planes for war*, or *plans for peace, our organization is at your service.*

Export Representative. Aviation Equipment & Export, Inc. 25 Beaver St., New York City

HYLAND MACHINE COMPANY
DAYTON, OHIO

40 MEN AND A JEEP



"GETTING there fastest with the mostest men" is still rule one for winning a battle. Today's wars depend upon the speed with which troops and their fighting equipment can be moved to the place where they are needed.

Rolling off production lines in America's great aircraft factories are huge freighters of the airways—planes as big as a boxcar that can span a continent between daylight and dark.

These leviathans of the air owe their tremendous carrying capacity as well as the speed with which they fly to the giant engines that power them.

To transmit the power of thousands of horses to whirling propeller blades, the gears in these engines must of necessity be held to such close tolerances that engineers have long considered them a laboratory product.

But laboratory methods of production could not be expected to furnish enough gears for the thousands upon thousands of fighting planes, bombers, and transports that are required to win a war.

The solution came in the production of gears of laboratory precision by mass methods, and today in the precision gear plant of Foote Bros., modern industrial might is helping solve the problem of more horsepower for engines—produced in ever increasing quantities to meet war's insistent demands.

These new techniques—these new skills translated into post-war production mean that peacetime speed reducers and peacetime gears will assure better machines—quieter machines—that promise greater savings to American manufacturers.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5301 S. Western Boulevard • Chicago, Illinois

FOOTE BROS.

SPEED REDUCERS • GEARS • SPECIAL ASSEMBLIES

BAKER TRUCKS



can help you to conserve *Man Power*

Here's how —

1. HANDLING MATERIAL FASTER
Saving man-hours means saving man-power. Baker Trucks cut time on handling operations.

2. HANDLING BIGGER LOADS
Baker Trucks, carrying pallet or skid-loads, eliminate piece handling, and release man-power for other work.

3. USING FEWER MEN FOR SAME JORS
One man with a Baker Truck can do the work of many men with hand trucks.

4. GETTING MORE OUT OF SKILLED LABOR
Cutting idle time of machines by servicing them with Baker Trucks conserves skilled labor.

5. CUTTING WASTE TIME
Waiting for material wastes man-power. Baker Trucks move material where needed, when needed.

6. DISPOSITION OF SCRAP
Keepingaislesclearandhandlingscrapefficientlywith Baker Trucks saves man hours.

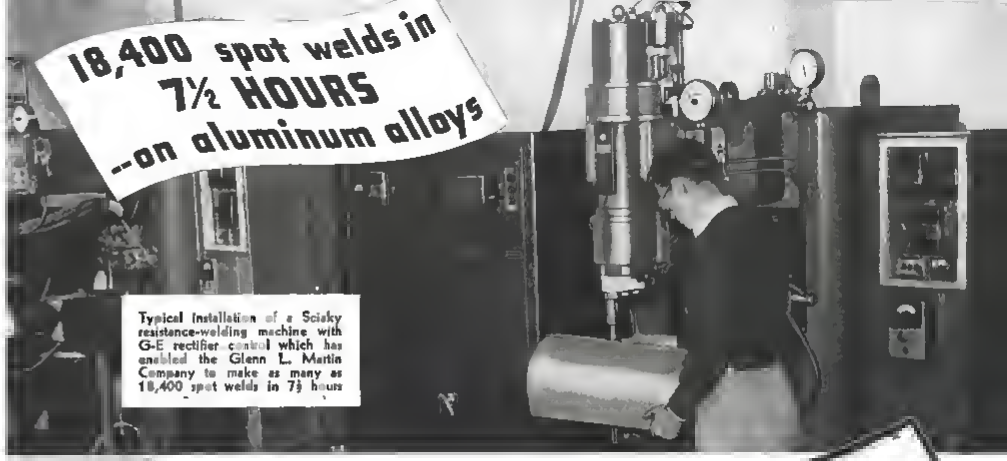
THE BAKER MATERIAL HANDLING ENGINEER CAN HELP YOU

He is a specialist and knows how to get the most out of material handling to conserve man-power. He is at your service.

BAKER INDUSTRIAL TRUCK DIVISION
of The Baker Raulang Company
2182 Wast 25th Street • Clevaland, Ohio



Baker INDUSTRIAL TRUCKS
In Canada: Railway and Power Engineering Corporation, Ltd.



Typical installation of a Sciaky resistance-welding machine with G-E rectifier control which has enabled the Glenn L. Martin Company to make as many as 18,400 spot welds in 7½ hours

GET CONSISTENT, HIGH PRODUCTION WITH G-E IGNITRON RECTIFIERS

on inductive-type stored-energy welding

PROVED by more than 18 months of actual use in supplying power to inductive-type, stored-energy welding machines, G-E ignitron rectifiers are helping users get fast, dependable operation—particularly in the aircraft industry

Because of its low kva demand, the inductive type of stored-energy resistance welding permits the use of low-cost plant distribution systems and reduces voltage drop. It also permits installation of welding machines at the most favorable point in the production line—even though this may be at some distance from the distribution transformers

Good voltage regulation afforded by the low kva demand also reduces the possibility of light flicker and limits interference with other welding equipment on the same circuit

Designed by outstanding electronics engineers, these G-E rectifiers are built for ease of installation and low maintenance. Whatever your problems on control for resistance welding — consult your nearest G-E office. Our control specialist will be glad to work with you. *General Electric, Schenectady, N. Y.*

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC



Four Good Reasons for Standardizing on These Micro Switch Actuator Brackets

Designed to Carry the Air Corps Approved Type R-31 Micro Switch . . .
For Complete Details of This Switch, Refer to Our Aircraft Catalog No. 70

These actuator brackets require no deviation permit as they are considered a part of the aircraft

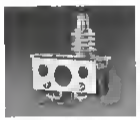
They are all specifically designed to accommodate the Type R-31 Aircraft Micro Switch

Their use permits faster and easier installation of the Type R-31 Aircraft Micro Switch

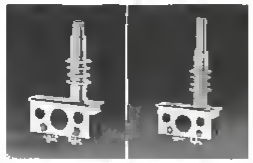
They make field replacement of Type R-31 Aircraft Micro Switch easy without disturbing bracket

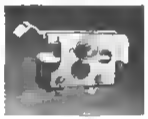


This new Type M B skeleton bracket saves weight It is complete with over travel plunger and is interchangeable with Army switches A-1 and A-2 Weighs only 128 lb 02 lb less than Army switches A 1 or A-2 The plunger on this bracket has a definitely controlled pre-travel and over travel—a total of ⅛" The Type R 31 Aircraft Micro Switch is sturdily supported in this skeletonized bracket by flush headed screws with lockwashers The mounting holes in the top of the bracket are on standard 1⅛" centers and accept No 6 32 bolts



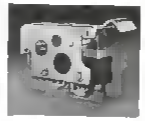
The Type M series of panel mounting brackets offer three lengths of threaded stems for easy positioning by hex nuts and lockwashers Switch operation takes place in the first 1/16" of plunger travel Over-travel ¼" or





¾" beyond the point of switch operation is provided The Type R 31 Aircraft Micro Switch is carried on two thru-bolts as shown In the illustrations

The Type T series bracket has met instant adoption as a throttle warning switch singly or in gangs They are operated by cams on the throttle quadrant or dogs on the cables Any switch held depressed can be instantly opened by the manual release without disturbing others in the gang As a general use limit switch the Type T bracket without the release is a sturdy mount and actuator for Type R-31 Aircraft Micro Switch Two thru-bolts make replacement easy



The Type H series of aluminum housings, one of which is illustrated here are complete with a plunger actuator which can be sealed against splash, dirt and oil It is fitted with A N outlet fittings, either straight or adjustable to 45 degrees The plunger over travel beyond the point of switch operation is ½" on the Type H and 1¼" on the Type HO3 The Type R-31 Micro Switch is easily installed on two mounting pins within the housing



Data sheet No 27 gives full engineering data on the series M brackets



Catalog No 70 furnishes general data on switches for aircraft- Ask for as many copies as you need

Micro Switch is a trade name indicating manufacture by Micro Switch Corporation

MICRO MS SWITCH

Manufactured at FREEPORT, Illinois, by Micro Switch Corporation

Branches 43 E. Ohio St., Chicago 11 Park Place, New York City • Sales and Engineering Offices Boston • Hartford • Los Angeles

BOMBARDIER'S *Friend*

We are the Bombardier's Friend, producing Bomb Racks, Bomb Sheckles, Cannon Parts and other military aircraft hardware 24-hours daily

And after our Bombardier and ALL his fellow fighters have won, we plan to continue serving him

Golden opportunities will follow victory. To those looking ahead the progressive Spriesch organization offers extensive facilities—plus invaluable experience in designing and producing dies for experimental work and mass production, for parts or complete assemblies, INGENUITY in stamping and metal machining.

Investigate NOW for the future by sending for a brochure picturing our complete facilities to be available AFTER VICTORY Joseph J Cheney, President



★ WE OFFER ★
INGENUITY
and extensive facilities to produce intricate or simple designs —experimental pieces or mass production—complete assemblies or parts with maximum accuracy minimum waste at reasonable cost.
AFTER VICTORY

Spriesch ★ SERVING THE U. S. ARMY SINCE 1928
TOOL & MANUFACTURING CO., Inc.
Established 1923
10 Howard Street, Buffalo, New York





The Fault Finders at Work...

ON the indicator in the Airport entrance-hall the midday Southbound is scheduled to depart at 11-55 ack emma It is now just 10-15 yet the great fifteen-place ship has already been out of its hangar for close on an hour.

When the time finally comes chocks are withdrawn and the twin engines roar into exultant crescendo for the take-off a small gang of men in oil-smeared overalls will be watching with approving confident eyes from the shadow of the control-tower Those men are the 'fault finders' and their job is a vital one Check, test and counter-check Everything must be just **right.** The safety and efficiency of the ship is only gained by long hours of unremitting toil

In the VOKES laboratories this same unremitting toil has been directed to the problem of filtration and today the Vokes technologists have just cause for satisfaction. The result of their research has been the introduction of **an entirely different principle** of filtration which gives the amazing percentage of 99 9% efficiency This is as near perfection as it is possible for human endeavour to reach These filters (available for air and for high and low-pressure oil systems) filter down to particles 0 00004 in. diameter



The value of such absolute filtration cannot be over-estimated Here at last is **pure** air and **pure** oil —bringing inevitably with them greater working efficiency less wear and tear fewer renewals less trouble We shall be pleased to answer all enquiries through our agents.

VOKES

VOKES LIMITED · FILTRATION EXPERTS

American and Canadian Agent: E Cartin, 101 Park Av., New York



DoAll HELPS DOUGLAS TURN 'EM OUT



★ C-47 Transports ★ A-20 Bombers
★ C-54 Transports ★ SBD Dive Bombers



Airplane Propeller Wrench made on the DoAll

WHY WAIT WEEKS FOR TOOLS or PARTS?

Make them the same day on a DOALL

• In the big Douglas plant, where time is master today, DoAlls certainly live up to their name. In one simple operation, they complete jobs which formerly required drilling, chiseling and hand-sawing. The DoAll further adds to its production versatility at Douglas by working from any design or angle for profiling jobs.

There are five models to select from, with throat capacities 16" to 60" and priced from $1000 to $5000 with motors.

A factory-trained man will call with a DoAll and show you its many uses, economies and time-saving features.

Incidentally, below is shown the exterior of one of the U. S. Air Corps mobile machine shops used for repairing damaged planes right on the spot. The DoAll is part of the equipment of each unit.

In addition to regular production work, the DoAll is a 100% patriot—ready to help out in emergencies. Makes new parts to replace worn or broken machine parts—Saws out hundreds of special tools and dies—Takes care of short runs of metal products in a fraction of the time required by other methods.

NO FURTHER MACHINING NECESSARY

The DoAll is today's fastest precision method of removing metal. Follows a hairline layout on both external and internal cutting. No further machining is required.



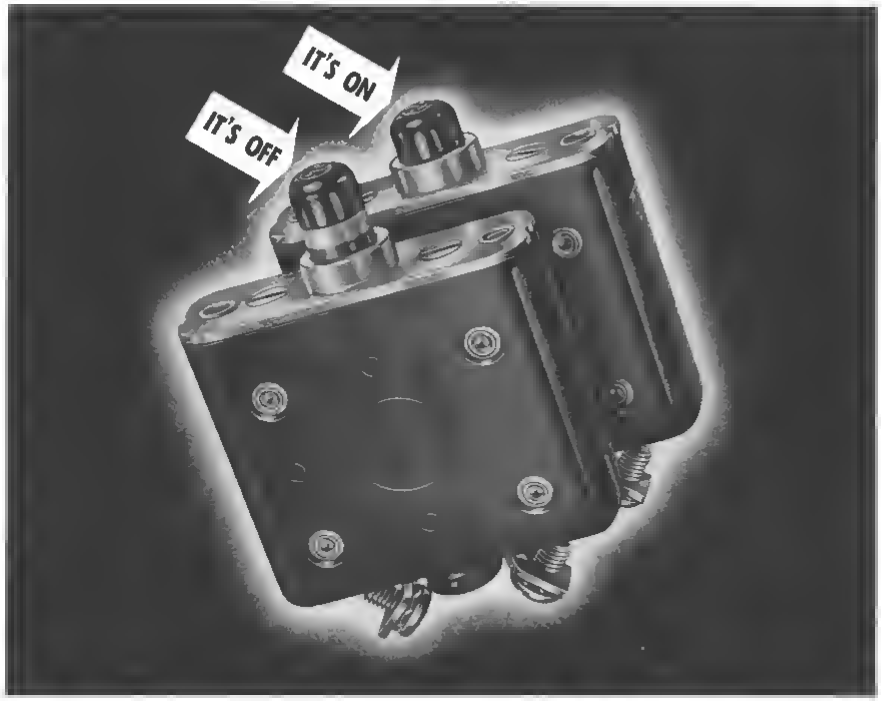
***READ THIS BOOK*—"DoAll on Production",**
a picture story of this little giant of industry.



CONTINENTAL MACHINES, INC.
1305 SOUTH WASHINGTON AVE • MINNEAPOLIS MINNESOTA

Associated with the DoAll Company Des Plaines Illinois.
Manufacturers of Band Saws and Band Files for DoAll Contour Machines

New Indicating Type KLIXON Aircraft Circuit Breaker



Day or night, this new Klixon Circuit Breaker tells a pilot whether the electric circuits on his plane have tripped out or not. A glance at the push button of the breaker on the panel tells the story. If he sees only the black part of the button everything is o.k. But if the button is extended and its luminous and red bands are visible, the pilot knows that a circuit is out.

Built for heavy duty service, this snap-acting breaker is available in convenient ratings from 15 to 50 amperes. It is not affected by shock, vibration, ambient conditions or harmless transient shorts. It is available both "non-trip-free" and "trip free". Is compact, light weight and has standard AN mounting dimensions.

Send for complete information on this new Klixon D 6750 Aircraft Circuit Breaker.

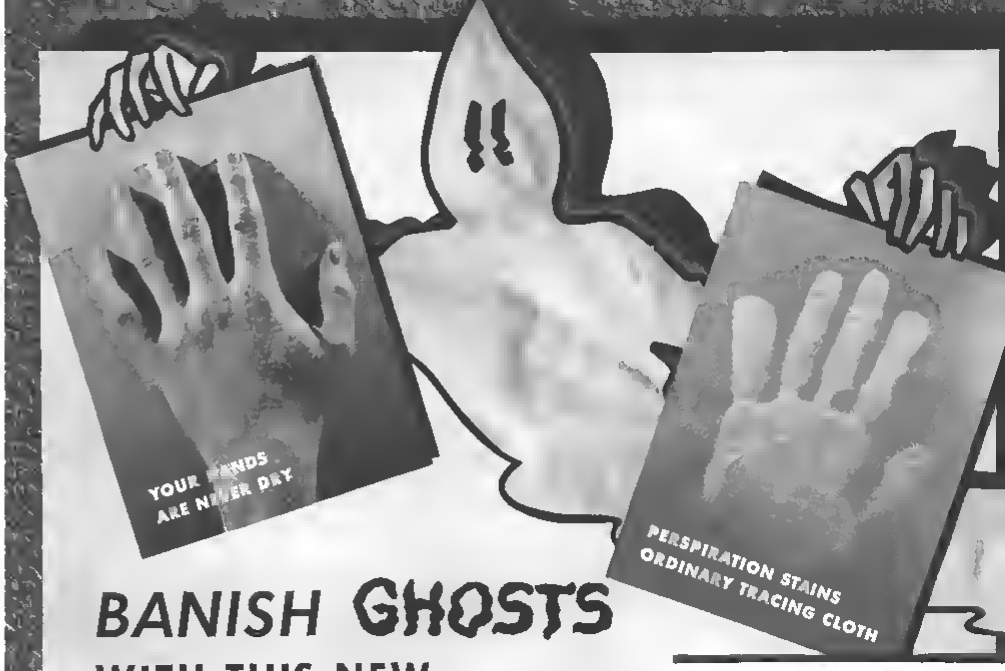


Don't forget to insist on Aircraft Motors with Built-In Klixon Protectors

If you want to make sure your aircraft electric motors will not burn out in a jam insist that they have built-in Klixon Overheat Protectors. Any motor manufacturer can give you D. C. motors up through 30 volts with built-in Klixon Protectors.

KLIXON

Spencer Thermostat Co., Attleboro, Mass.



BANISH GHOSTS WITH THIS NEW TRACING CLOTH

PHOENIX is the new kind of tracing cloth, proofed against perspiration stains and water marks —*that holds erasure scars at a minimum*. PHOENIX gives you clean tracings, in pencil or ink, free from untidy "ghosts" that reproduce on blueprints.

An exclusive new process is responsible for this amazing performance, a process which defies moisture, and gives PHOENIX its unusually durable working surface. You use harder pencils . . . get sharper lines with less tendency to smudge. Even 6H pencil lines show clearly, and reproduce strongly. You don't mar the surface when you erase; erased areas take pencil smoothly —and ink without feathering. Its new white color and its increased transparency provide excellent drawing contrast . . . produce strong blueprints.

Give PHOENIX your own drawing board test. See your K&E dealer, or write for a generous working sample and an illustrated brochure.

PHOENIX DEFIES MOISTURE GHOSTS

Perspiration and water splashes on ordinary tracing cloth create "ghosts" which reproduce on blueprints. PHOENIX Tracing Cloth withstands actual immersion in water for fully 10 minutes at a time! *Perspiration and water marks will not stain it!*



PHOENIX LESSENS SMUDGE GHOSTS

The new improved surface of PHOENIX Tracing Cloth permits you to use harder pencils (5H and 6H) and to get sharper lines with less tendency to smudge.

Result: Cleaner tracings and blueprints.



PHOENIX REDUCES ERASURE GHOSTS

Ordinary tracing cloths become scarred when erased. Erased spots produce ghosts on blueprints.

PHOENIX has a durable drawing surface that reduces working scars to a minimum.



K&E *Phoenix*

REG U.S. PAT. OFF.

TRACING CLOTH

for pencil *and* ink

EST. 1867

KEUFFEL & ESSER CO.

NEW YORK · HOBOKEN, N. J.

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A NEW

Confidential Engineering Service

OFFERED BY **PARAGON RESEARCH, INC.**

(PAUL OUBOSCLARD, Pres., Licensed Professional Engineer)

IN COOPERATION WITH **FARNHAM**

Paragon Research, Inc., in cooperation with the Farnham Manufacturing Company, announces the successful inauguration of a confidential research and engineering service to aircraft manufacturers. This new service is organized to advise and assist designers in coordinating future wing designs with the machinery to be required for their efficient fabrication.

This service, divorcing the research required for future designs from the urgency of present manufacturing schedules, promotes the efficiency of both these important phases of aircraft production

★ ★ ★ ★ ★

PARAGON RESEARCH INC. cooperating with

FARNHAM MANUFACTURING CO.

1600-1646 Seneca Street, Buffalo, New York

This service is supported by Farnham Manufacturing Company as a part of its contribution to the War Effort. No charge is made for problems Paragon Research is prepared to accept within its capacity. Only defense problems considered—no peace-time problems should be submitted.

Franklin

FRANKLIN ENGINES GO TO WAR!

To the thousands of fighter pilots and pilot instructors who received their first training in a Franklin powered plane, it will be welcome news that Franklin engines are going to war!

Today and for the duration, Aircooled Motors Corporation and its employees have but one aim—ever-increasing production of new aircraft engines developed by Franklin engineers for the Army Air Forces and the Bureau of Aeronautics, U. S. Navy.

These Franklin military and naval engines are destined to prove themselves brilliant successors to the peacetime Franklins . . . the engines that are now doing such valiant service in the CPT and CAP programs.

For both the old and the new are products of the same unique engineering skill, based on 42 years experience building ever-finer air-cooled engines.

AIRCOOLED MOTORS CORPORATION
SYRACUSE, N. Y.

Kingfishers IN ACTION



Hundreds upon hundreds of Kingfishers are constantly on duty with the Navy over the seven seas.

Seeking out the enemy, attacking submarines and directing gunfire are some of the vital tasks assigned to these versatile Vought-Sikorsky observation scouts.

VOUGHT-SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
One of the three divisions of
UNITED AIRCRAFT CORPORATION

The AVIATION NEWS

BLAINE STUBBLEFIELD Washington C. E. F. MACAULEY New York E. EUGENE MILLER New York JOHN FOSTER JR. New York

Towers Transferred To Pacific Post; McCain Heads Bureau of Aeronautics

WASHINGTON (AVIATION Bureau)—Rear Adm John H Towers has been relieved as Chief of the Bureau of Aeronautics and is succeeded by Rear Adm John S. McCain who has just left air command in the Pacific Fleet

Adm Towers, promoted to the rank of vice admiral is ordered to a newly created post called Commander Air Force, Pacific Fleet Navy's official statement says it is 'the most important air command afloat in the Navy'

Navy officers and observers



VICE ADM JOHN H TOWERS

privately expressed the opinion that the Navy has lost its most authoritative voice in its High Command here Adm McCain age 58, is a distinguished officer with limited air experience He learned to fly only five or six years ago, when he was shifted from the line to aviation to meet the requirements for senior officers

Critics expressed disappointment that Secretary Frank Knox apparently had not meant veteran air officers when he said recently that aviation men would be advanced quickly to fill important posts Apparently he meant seniors who have the minimum of air training those sources feel.



REAR ADM JOHN S McCAIN

As Commander Air Force Pacific Fleet, Adm Towers will be principal air adviser to Adm. Nimitz, Chief of the Pacific Fleet and he will be the relief of Adm William F. Halsey Jr., Task Force Commander

The term "air force" is new to the Navy It was used after careful consideration Its only application so far is to the new job created for Adm Towers

New AAF Regulations

The War Department announced new Army regulations listing the aeronautical ratings and placing command of tactical units of the Army Forces only under officers qualified as pilots Twelve ratings are open to officers, warrant officers, and flight officers who qualify They are Command Pilot, Senior Pilot, Pilot, Senior Balloon Pilot, Balloon Pilot, Senior Service Pilot, Service Pilot Senior Aircraft Observer, Aircraft Observer, Technical Observer, Glider Pilot and Liaison Pilot

Three Army Calls For Trained Men

Army Air Forces needs more aerial gunners After a brief training period, graduates become sergeants and move to their combat teams at bombardment training stations on a flying pay status of $144 a month Age limit is 18 to 30

Transport Command needs skilled radiomen and other specialists to service its cargo planes These men will be enlisted as privates, but their technical training will earn them a technician or noncommissioned officer rating Application for enlistment is made directly to any of the stations of the Air Transport Command

Maj Gen. George E Stratemeyer, Chief of the Air Staff calls for maintenance crews and communications specialists Machinists, mechanics, electricians, armament experts, radio operators repairmen and other specialists are much needed Skilled men between 18 and 44 enlisting under this program have the privilege of joining either the AAF, Signal Corps, or Ordnance Inducted as privates their advancement is fast with opportunity for commissions

Kaiser Gets Order

Washington (AVIATION Bureau)—War Production Board has authorized Henry J Kaiser, West Coast shipbuilder, to construct three large cargo planes at a total cost of approximately $15,000,000 The planes are to be constructed from plans which are being engineered by the organization of Howard Hughes, and will be built in Hughes' West Coast plant

They will be flying boats built of plastic bonded plywood by the Duramold process, with an estimated capacity of 60 tons The first according to Kaiser's estimates, can be delivered in 15 months, the second 5 months later

Skilled Women Pilots Give Air Training

As part of a program to utilize women flyers, Secretary of War Stimson has announced the appointment of Mrs Nancy Harkness Love of Boston Mass to command the Women's Auxiliary Ferrying Squadron, under the Air Transport Command, and Miss Jacqueline Cochran of Stamford, Conn., as Director of Women's Flying Training



International News Photos

TO ALASKA ON SCHEDULE

Army Air Forces Douglas transport delivers materials to the fighting forces somewhere in Alaska Operating under direction of the Air Transport Command, the plane has landed on schedule on a new field which was carved out of wasteland Note the size of tires on the ground at left.

within the Army Air Forces

The Women's Auxiliary Ferrying Squadron is described as an experimental unit of women flyers for ferrying Army planes from factories to airfields. According to tentative plans, the initial group will be made up of about 50 women all of whom will have Civil Service status and will receive $3 000 per year Qualifications for women pilots will be substantially the same as for male pilots in non-combat flying

The WAFS will fly small planes at first such as training and liaison planes, within the United States

Mrs Love received her commercial license in 1933 and now has more than 1,200 hours of flying time She has a 600 hp rating as well as instrument and seaplane ratings

Under Miss Cochran, an outstanding pilot women will be trained in non-combat flying to qualify as operating personnel for Mrs Love's and such other units as may require it

I am delighted said Miss Cochran in commenting on her appointment, 'that the more than 3 000 licensed women pilots in America are going to have an opportunity to prove their competence to serve in theu chosen field in the war"

CPT Calls For Volentaars

Volumteers are called for by the Civil Aeronautics Administration CPT program to be trained for the Air Forces as flight instructors transport, glider and liaison pilots

Physical requirements are not as stiff as for combat cadets and age limit is 19 to 36 Training begins at one of the 600 colleges participating in the CAA program, with room, board, and a complete flying course provided by the CAA After from eight weeks to eight months of CAA instruction they enter Army flying schools and have the opportunity of qualifying for a commission or for the rank of staff sergeant with flight pay Pilots with 150 or more hours can qualify as instructors after a two-month course

Navy Board Raarganizad

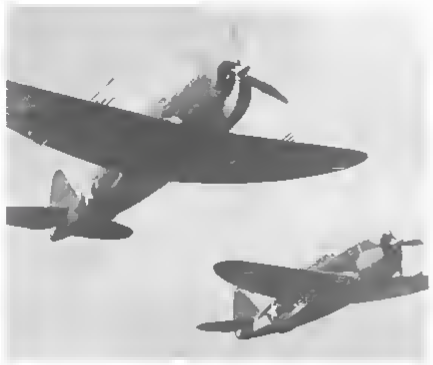
Navy announces reorganization of its General Board adding two members, for the increased duties of wartime The board has no executive authority but its advice often carries great weight with the Navy in matters of design construction and strategy

The two new members are Adm A H Hepburn chairman and Adm T C Hart The four others are Adm C C Bloch Rear Adms W R Sexton and G J Rowcliff and Capt J J Mahoney secretary All but Rowcliff and Mahoney are retired.

Critics immediately pointed out, that, with aviation dominating naval actions in the Pacific and all over the world, there is no air officer on the General Board The Navy made no changes in the board, and had no comment as a result of the criticism

When AVIATION inquired concerning the absence of an air member on the board, one official said 'Navy aviation has nobody old enough to be a member."

Meanwhile Col Hugh J Knerr formerly chief of staff of the Army Headquarters Air Forces who retired for physical disability, has published an article quoting Adm Ernest J King Adm William V Pratt Adm Clark Woodward, Adm William Leahy and Adm Yates Stirling in various statements to the effect that aviation is a minor factor in warfare



THUNDERBOLTS ROAR

First flight pictures of the Republic P-47 Thunderbolts released by the War Dept. Powered with 2000 R&W horses turbo-supercharged, heavily armed and armored this high altitude fighter is the biggest single piece of opposition the Axis has to contend with to date

Hughes on Active Duty

New York State Wing of Civil Air Patrol has lost its second commander to the armed forces as Garnet N Hughes goes on active duty as Captain Army Air Forces He has reported to an air base in the South

Beckwith Havens, who headed the wing at the time of its organization had previously been called to active service as Lieut.-Comdr, United States Navy

Hughes has been succeeded by Stuart C Welch, group commander of Buffalo Welch is a pilot from World War I days when he was a member of the RFC

Brazil Air Force Grows

Brazil's declaration of war against the Axis has relieved the United States of heavy naval and air patrol duties along the Latin American coast If the war goes on very long, a good portion of Brazil's great resources will be converted to war equipment and undoubtedly considerable air power

The nation's first aircraft engine factory will be in operation early in 1943

Under a licensing agreement with Wright Aeronautical Corporation, the government organized company "Fabrica Nacional de Motors," will manufacture seven- and nine-cylinder *Whirlwinds*, ranging from 235-450 hp Brazilian engineers have spent the past eight months studying procedures and specifications for similar engines made in this country

Brazil is strengthening her military air force as rapidly as possible Today 102 trainees are being instructed in this country—64 as pilots 30 as service mechanics 6 as instructor mechanics and 2 as aeronautical engineers It is known that Brazil has seven air regiments, an air cadet training school, and over a thousand civilian pilots who can be used for military assignments. Pilots in training here will serve as instructors but it is expected that in the future all training will be done by either Brazilians or by man sent to Brazil as instructors

Mare Thenderbolts

The first P-47 *Thunderbolt* fighter has come off the production line at Republic Aviation Corporation's new Midwestern plant three months ahead of schedule and before finishing touches had been put on the building

The plant is the largest of Republic's units and was built in less than six months Contracts were signed in March and ground broken for the new unit in April

Pacific Bax Scara

Reports from the Pacific theaters of war on American vs Jap planes from Feb 1 through Aug 1 show the following respective losses

Jap Planes Destroyed	Army Air Forces Losses
234	109
218*	84*
Total 452	193

* The score established by the American Volunteer Group—the Flying Tigers—from Feb 1 to the time of the absorption by the AAF on July 4



PLANE A WARTIME NECESSITY

Increased aviation business coupled with the fact airline and rail travel was becoming more difficult prompted S F Bowser & Co manufacturers of liquid control systems to purchase their own plane for maintaining proper contacts in a growing field Shown here is I W Baldwin manager of the Aviation Division with the Culver two place plane with which he goes where and when he wants Baldwin is an officer in the Indiana Civil Air Patrol Wing and both his and the plane's time have been offered by the company for CAP duties



EMPLOYEES BECOME SCRAP SNOOPERS In addition to its year-round salvage program a New England war plant recently enlisted all its employees in an all out scrap round up Workers searched their homes offices work-benches, tool chests and cheap floors Over 350 000 extra pounds of metal scrap was collected *Are you making all your employees scrap conscious ? Have you tried an operation system to stimulate scrap collection?*



SEGREGATION MINIMIZES SCRAP LOSS A western aircraft plant has more than doubled its scrap collections by applying a centrally directed salvage system All metal scrap is segregated into solids and machinings and also by alloy content right at the machines Scrap containers are color banded and labeled to identify clearly what goes into each *Have you set up an efficient scrap collection system at your plant? Is scrap carefully segregated?*



SOME SCRAP ISN'T SCRAP! One airplane builder has found that metal pieces left over from making larger parts can be used to make smaller parts The worker shown is stamping small parts from metal cutouts resulting from making large aluminum drop hammer and punch press dies and by altering template blank sizes changing drop hammer and punch production and improving layout *Are you using every means to get maximum production out of the metal supplied to your plant?*

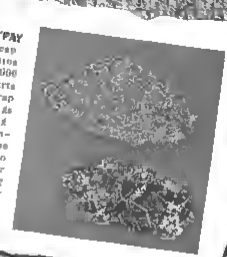
THE SCRAP IS COMING IN . . . BUT NOT FAST ENOUGH!

We have proof that industry is cooperating in the drive for scrap metals — proof measured in thousands of tons But mills must get *more* iron and steel scrap if they are to meet the gigantic needs of war industry

Don't forget steel gers to work on the battlefront quickly when plenty of scrap is available Scrap is already metallic therefore, less ore needs to be converted into pig iron per ton of steel produced By remelting scrap to make new steel, more tons of high-quality products can be turned out in a hurry for war purposes

SEGREGATION OF SCRAP IS IMPORTANT! By making it easy for steel mills to identify accurately the alloy content of your machinings and other scrap, you help to speed production of NE Steels and make possible full utilization of valuable alloys your scrap contains

FLOOR SWEEPINGS ARE "PAY DIRT" —Everyday the sweepings of an east coast ammunition plant yield more than 1000 pounds of usable small parts and a big pile of scrap metal Sweepings are screened through wire mesh. Then mud and sorting devices finish the job. Usable parts go back to stock and scrap is shipped for salvage. *Are you pleasing every pound of metal from your floor sweepings?*



AMERICAN STEEL & WIRE COMPANY *Cleveland Chicago and New York* CARNEGIE ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago* COLUMBIA STEEL COMPANY, *San Francisco* NATIONAL TUBE COMPANY, *Pittsburgh* TENNESSEE COAL, IRON & RAILROAD COMPANY *Birmingham*

UNITED STATES STEEL

AT THE FRONT *in peace and in war*



In commercial flying, American Airlines Flagships have been "at the front" with many outstanding transportation achievements.

In military flying, Bell Airacobras are "at the front" with devastating effect on enemy aircraft.

Lubrication has its share in the efficiency records of both the Flagships and the fighters.

For more than 9 years American Airlines' great fleet has been lubricated exclusively with Sinclair Pennsylvania Motor Oil. This same oil is used by Bell Aircraft Corporation in the rugged tests of Airacobras before they go into fighting service.

For full information about Sinclair Pennsylvania and other Sinclair aircraft lubricants write Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.

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DELIVERING THE GOODS

Converted Douglas transport which once carried passengers in this country now serves as cargo carrier to get the material where it is needed. Photo shows stores being unloaded at a repair and supply depot of the U. S. Army Air Forces Command somewhere in England.

Air Express Has Birthday Celebrates 15th Year

Air Express recently reached the 15th anniversary of its existence. In the first full year of operation there were only 17,000 shipments by air as compared with over 1,300,000 shipments in 1941. This year it is expected to reach the 2,000,000 mark.

As air speeds increased from 100 to 200 mph, rates went down. In 1927 a 5-lb package from Boston to San Francisco cost $15; today it costs $4.80. Time was cut from 33 hours to 17.

About 30 percent of all air express originates at or is destined to an off-airline point or moves part way by rail. Commodities carried in the 15-year history ranged in size from mosquito eggs to a 35,000 lb. edition of a national magazine.

United Air Lines says it is the largest air cargo carrier. In July company flew 743,914,000 express pound miles for a gain of 191 percent over the same period of 1941.

Marines Seek Pilots

Civilian aircraft pilots with necessary qualifications are now eligible to apply for commissions in the United States Marine Corps Reserve as flight instructors or transport pilots, the Navy announced. These pilots ordinarily will be commissioned as second lieutenants, although some may get higher ranks because of their age and experience.



TROPICAL WARTIME AIRPORT

International Photo

A Marine Corps Grumman "Wildcat" taxies toward a forest covered hangar after landing on a roadway carved from the jungle of a South Sea island. Conditions are typical of those under which Army, Navy and Marine pilots operate every day in the South Pacific front where United Nations are going on offensive against the Japs.

THE WASHINGTON WINDSOCK



By BLAINE STUBBLEFIELD

The Air Force lost its campaign to adopt the term *Flying Fortress* for all four-motor bombers. It wasn't Boeing alone that put the quietus on it; several other manufacturers, particularly engine builders, chimed in. They were identified with this trade name, and they didn't want to lose the benefits. Boeing doesn't know for sure who thought up *Flying Fortress* but they think probably it was C. N. Monteith.

When a basic war metal is not short, it's news. Contrary to general opinion and some statements by the press and despite a line in AVIATION'S War Communique No. 5 last May, there is not and has not been a shortage of aluminum sheet, so far as the Aluminum Company of America is aware. ALCOA has pictures of a 5,000,000-lb. stockpile of sheet in a warehouse. Witnesses for a large airplane manufacturer, who recently created an impression in Congress that the company's output was slowed by lack of sheet, wrote ALCOA saying they had not intended to convey this notion, that no shortage existed.

As aerial war goes higher—thirty, thirty-five, forty thousand feet—troubles multiply. Instruments freeze, the crew, despite all aids to altitude, declines in efficiency. One big problem is supercharging. The charger, running at great speed and at red-hot temperature, takes the trickiest of alloy steels to make it stand up. How engineers are solving this problem as the charger load increases will be a great technical yarn—after the war.

Airline operators would feel sad to leave those overseas war routes they are flying for the Army. So the soothsayers of Washington are telling us that said operators will apply for certificates when the war ends. Then, with a sly look, they add the payoff, Pan American Airways and American Export, which now have certificates, will intervene, no doubt as pals.

Now that he's back, we can tell you that Dr. Ed Warner of the Civil Aeronautics Board, has been in England again, doing the same thing he did on his previous trip. He came into his office and sat down as if he had been to lunch, they say.

Throughout the World, more people are trying to do new jobs they know nothing about than ever before—and Washington is the capital of the World. There are 19-year-old kids and retired mothers sitting at desk jobs in this town who don't know where their basketfull of paperwork comes from or where it goes. They can't find their way home on the street car yet. The other day a man was commissioned major in the Air Force. An old soldier-friend took him behind the bushes in Rock Creek Park, showed him how to salute.

New Trophy Policy

Gill Robb Wilson, president of the National Aeronautics Association, announced future awards of the Collier Trophy will be made under a new policy by a committee including all previous recipients of the prize.

Personnel of the group to award the 1942 cup will include representatives of four non-governmental aeronautic agencies. The Aeronautical Chamber of Commerce, the Institute of Aeronautic Sciences, the Air Transport Association and the National Aeronautical Association.

Until this time, awards have been made by a committee appointed by the president of the NAA according to a set formula.

Army Needs Mechanics

The Army Air Forces, the Signal Corps and the Ordnance Department need skilled mechanics and tech-

nicians The War Department has announced that an intensive recruiting campaign will be launched to supply the demand. Men between 18-44 who pass the Army physical are eligible Those accepted will be enlisted as privates with the possibility of non-commissioned and technician s ratings and rapid promotion Those doing mechanical work in civilian life should contact the nearest Army recruiting office for details

Rain, Gas, Don't Mix

An unusual amount of rainfall in some sections of the country and an increase in the frequency of forced landings due to the presence of water in gasoline indicates that water has found its way into airport storage tanks says CAB Storage tanks should be checked and drained of water Gasoline systems of all airplanes stored outdoors during the recent rainy period should be checked for water The only thorough way to clean such a system is to remove the sediment bulb drain the system and flush it with clean gasoline, tilting and rocking the ship meanwhile

Air Literature Needed

An urgent appeal for donations of aviation literature of all kinds to help millions of student pilots in military and civilian training courses keep up with their 'hangar flying' has been issued by the National Aeronautic Association Any donations may be sent to the Association's offices at 1025 Connecticut Ave N. W., Washington, D C.

Heads Air-Borne Unit

Washington (AVIATION Bureau)—Col Elbridge G Chapman, Jr. has been named to head the Air Borne Command at Fort Bragg, N C. succeeding Brig Gen William C Lee who has been assigned to command the 101st Air Borne Division now being organized the War Dept. announced.



KING GETS INDUSTRY PLEDGE

Adm Ernest J King chief of U. S. Naval forces and James F Lincoln head of Cleveland Chamber of Commerce and president of Lincoln Electric Co attend Chamber luncheon at which King outlined Navy's needs and Cleveland industry representatives pledged 100 percent cooperation

CALLING NAMES

James W Ellicott former *Los Angeles Times* real estate editor and Los Angeles Stock Exchange secretary is the new director of industrial relations and **Don Rose**, also formerly of the *Times* the new assistant registrar of the Curtiss-Wright Technical Institute

H W Longfellow, mgr of UAL's foreign and agency department has been commissioned a major in the Army Air Corps and assigned to Gen Eisenhower's staff abroad He served in World War I and was once reported 'killed in action'

J T Callahan, with **W F Goodrich** since 1926 has been named western district mgr. of their National Sales and Service Division succeeding **Walter W Themen** who has retired for duty as a major in the Office of the Chief of Ordnance War Department

Ralph W Tetzlaff former vice-president of Wittek Mfg Co now serving as lieutenant in the U. S. Army was given a Bond Birthday dinner at which Wittek employees celebrated his birthday and bought war bonds

Earl Dingley former executive vice pres. has been named now president of Marmon-Herrington To assist him in his new duties the following new vice presidents have been named **R C Wallace** vice-pres in charge of engineering **Seth Klein**, vice-pres in charge of production **C Alfred Carmichael** vice pres in charge of public relations and **George E Reynolds** vice pres in charge of the Indiana District **William B Nullingham** 6 names succeeding **D I Glassbrenner** who has entered military service **H Deboard** treas **L M Donnell** asst. treas and **John J Klopp** asst to **A W Herrington** who continues as active chairman of the board.

James H Davis former gen mgr of General Motors Marine Division has been made special assistant to **E F Johnson** vice-pres in charge of Eastern Aircraft and other divisions.

C E Westman has been elected vice pres of the Air Transport Association and the following directors elected **W A Patterson** UAL **Jack Frye** TWA **E V Rickenbacker** EAL **C M Moseley** American **G T Baker**, National **J W Miller** Mid-Continent and **Cyril Hunter**, Northwest.

Elden M Wilson is chief engineer of the recently organized Century Engineering Company, engaged in plant layout tool design process and mechanical engineering for West Coast and Eastern Aircraft manufacturers and subcontractors. He was formerly with the North American and Northrop companies

E S Taylor, director of the employees suggestion system of the Pullman Co. has been elected president of the newly formed National Association of Suggestion Systems **F A Dean** of TAT was elected secy **N C Marmeduke**, of Illinois Central R R. treas and **H W Seinworth** of Swift & Co **F R. Evers** of Public Service (Northern Ill.) and **H F Foley** of Peoples Gas Light directors

J M Luther is the new assistant chief engineer at Globe Aircraft Prior to accepting his appointment he did designing work on Curtiss-Wright's P-40 series He will be on the *Bell Diver* and the *Sea Gull*. He has also been associated with the engineering staffs of Vultee North American and Lockheed

E C Ball, Harrisburg station mgr for TWA has been granted leave to enter the Army Air Transport Command **W R Hinnebarg** will transfer to succeed him at Harrisburg and **R A Gerlin**, formerly chief radioman has been promoted to succeed him

Lt. Hugh G Nicholson Jr. is the new director of training for Pal Aero Mira Loma and Palmdale Flight Academies replacing **Capt. William H Clark** who was called to active duty with the Army Air Forces

Cecil & Presbrey Inc has been appointed advertising counsel to **Fairchild Engine & Airplane** and its affiliated and subsidiary interests

John Munro becomes vice pres in charge of a new procurement division **H W Anderson** vice-pres of the Aviation Division and **M J Rice** vice pres of the Quiskwork-Whiting Division corroding three departments of Whiting Corp to speed up war production

William E Vogt has been elected secy of the Electro Metallurgical Sales a U C unit

Howard S Wolch becomes new president of Eisemann Magneto Corp He will also serve as director and president of Alward Corp

Gage Muse has been appointed supt of flight operations of Ahrtil in Alrlines He was formerly asst to vice pres of operations

A L Spangenberg becomes gen mgr of the new hydraulic division of Harvill Aircraft Die Casting Corp. He was previously with Douglas Aircraft Co and hydraulic specialty companies

John K Colgate has been appointed vice-pres and treas of Tyson Roller Bearings

Brig Gen Ira C Eaker and **Col Frank A Armstrong** have been awarded the Silver Star for their part in leading the *Flying Fortress* bombing of Rome

Miss Eve Freeman has been appointed new San Diego traffic mgr for TWA.

Evelyn Nell Hummell, Boeing's only girl aerodynamicist is to receive a Salute of Honor for her gallantry in daily living Her husband **Lt John Hummell** has been reported missing since Bataan

Ray C. Samuelson has been appointed airport traffic mgr of Pan American's Alhmbra Division and **Woodford S Book** son has been appointed airport engineer

W D Morgan has been appointed treas of the Carroll Corp Ho was formerly asst mgr of Ernst & Ernst CPA firm

F M Hoefer has been elected vice pres and gen mgr of Harvill Aircraft Die Casting Corp Simultaneously **James F McNamara** was elected chairman of the board of directors **Stanley M Tracy** chairman of the executive committee and **Col Temple N. Joyce** named vice pres of the firm and chairman of the advisory committee

Frederick Detweiler has been named division accountant and assistant treas and **George Krane** asst treas and asst secy of Pratt & Whitney a Western Division **William R Robbins** has been appointed division controller and **James R Susman** asst treas and asst secy of P & W a Eastern division

Air Commodore D. V "Andy" Carnegie left for England where he will be in charge of all flight training for the RAF He has been in charge of British training in this country for the past 18 months

Morgan C Monroe has been named asst director of industrial relations and **Frank C Hargreave** personnel mgr of Republic Aircraft.

Torrell C Drinkwater takes over as executive vice-pres **Stanley R Sheets** as gen mgr of the Modification Center and **O R Benolor** chief pilot and other flone mgr of Continental Air Lines

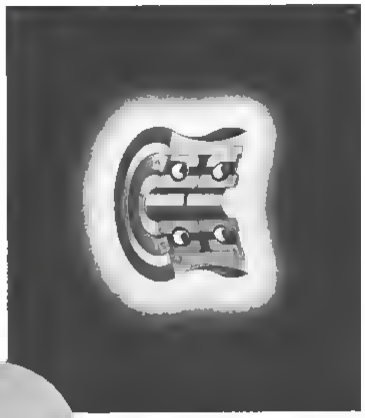
Miss Jean Foley is one of the 22 new women passenger agents UAL has installed The new agents have been assigned to key terminals where they will assist men passenger agents in handling traffic

W. M. Packer has been assigned important engine relations work at the Packard plant

Robert P Wright is named asst treas of Penn Central and **Albert Englert** named asst to the personnel director

Lt. Sam F Junkin is the first American fighter plane pilot to gain a victory over a German plane in combat operation



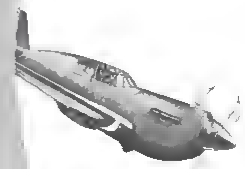


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THE MILLER COMPANY announces the new MILLER Engineered non-metallic fluorescent lighting reflector... offering still further savings of critical material ...and with the same man-made daylight performance.

You know, of course, that the MILLER *Continuous Wireway* Fluorescent System has always offered conspicuous savings of critical material (taking *all* items into consideration from power source right through to controls). Now, we are pleased and proud to tell you that the new MILLER-Engineered *non-metallic* reflector will increase those savings substantially — thus contributing still further to the war effort.

Significantly too, so far as the lighting of your plant is concerned, this further metal saving means absolutely no sacrifice in any way of the high standards of MILLER lighting.

MILLER 50 FOOT CANDLER or 100 FOOT CANDLER will provide fine, man-made daylight — adequate productive illumination evenly distributed over every working surface.

Your employes will see better, feel better, work better with this kind of wartime lighting.

There are other noteworthy MILLER benefits, too — savings in power consumption, in installation time and in installation dollars. *Why don't you write for all the facts today* — and let us have a MILLER engineer help you plan the most efficient lighting layout for your individual war production problems.

(Representatives in principal cities)

BUY U S WAR BONDS

MILLER

50 FOOT CANDLER
100 FOOT CANDLER
MILLER TROFFERS
Continuous Wireway Fluorescent Lighting Systems

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844

● MILLER offers a complete line of filament and fluorescent lighting equipment.

Combat Plane Production Up Again But Parts, Engines Delay Flattens

Output of American airplane plants in July was up 11 percent over June. The President had said that May production was about 4000. But the output had fallen off in June, apparently about 10 percent. This drop was due to completion of an order by a large trainer manufacturer. It is good news that combat craft production was not down.

It is estimated that in July the industry just barely bettered its May output. One reason for this production plateau is the disbetance that has lately affected the whole war program. Aircraft manufacturers have been short of aluminum forgings, shapes, extrusions, various parts, and engines. In other words the airframe industry outran its purveyors, mainly because mass production went faster than could be hoped.

Another point is that the industry is having to produce large quantities of spare engines and parts for planes on the battle fronts. Thus actual production is much better than it looks in terms of assembled airplanes.

Engines are currently not so much a bottleneck as they are a limiting factor on airplane output. Engines are a metallurgical problem, as WPB Chairman Donald Nelson aptly put it. Practically all of the electric furnaces in the country are making special steels for airplane engines and it is production of these steels that limits engine output.

Col. John H. Jouett, president of the Aeronautical Chamber of Commerce, announced that over five billion dollars worth of warplanes, engines and propellers had been produced by the aircraft industry during three years of World War II and that we have more than 30 types of planes on the war fronts. Meanwhile, development of new models is being pressed.

Since Dec. 7 plant space has increased 25 percent, employment has increased more than 50 percent, up to July 1 manhours had increased 75 percent, engine horsepower output has been boosted 75 percent, and tonnage of airplanes produced has gone up 150 percent. Production during the first half of 1942 substantially exceeded the entire output of 1941, he reported.

America's production is still nowhere near the top. The goal is 125,000 next year, or about 10,000 per month, double the rate today. This will be achieved by speeding up the flow of fabrications to existing plants by speeding engine output and by the addition of new plants to make planes, engines, propellers. About 30 such plants are in course of construction and they will be coming in this year and next.

The number one question is production of combat aircraft — the best offensive weapon we have." Mr. Nelson declared adding that WPB is taking every possible means to assure a flow of materials to airplane plants.

No announcement of any spectacular percentage increases should be expected for two or three months yet, however, for the problems involved are too complex.

B-17 "Production Density" Breaks Up Assembly Line

Boeing Airplane Company's "E" award production record was largely due to its new "production density" assembly system. Instead of one long assembly line carrying practically the entire plane, the company uses several long but compact production lines for major assemblies, in which each component part of the plane is nearly completed before final assembly begins.

In effect, Boeing has no assembly line, but rather, a final assembly fixture. This is a station at which complete major sections, arriving from the several production lines are joined and wires and tubes connected. There are two positions for final inspection.

Manufacturing process of the *Flying Fortress* is broken down into seven distinct major assembly operations: (1) skeleton of the forward fuselage, (2) forward half of fuselage or nose section, (3) tail section, or rear half of fuselage, (4) tail turret—that part aft the dorsal fin, (5) fuselage final assembly where the three parts of the fuselage are put together, (6) wing structures, where the wings are built in sections and (7) wing installations where the engines, gas tanks, and other items are installed on the wings.

This system is said to make for maximum use of machine tools and floor space and eliminates the waste motion of swarms of workers jostling each other trying to get at the hundreds of jobs on a plane being assembled in toto.

New Gun Turret

A new electric-powered ball-shaped bomber turret designed by the Sperry Gyroscope Company is now being produced in large quantities by Briggs Manufacturing Company.

Both the American and British air forces contend that this turret is far superior to anything in existence. The fire power of planes mounting the turret will be increased considerably.

The electrically operated and locally controlled gun enclosure will revolve completely on its vertical axis and can be tilted through an arc of 60 deg. giving the operator a maximum field of fire. The aluminum ball has plastic windows and a plate glass sighting window. It has considerable armor plating giving the gunner a maximum of protection.

P-38 Strips Rubber

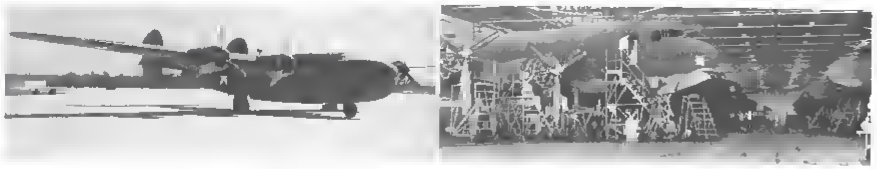
Lockheed is stripping its P-38 of rubber, using instead bound hair, felt. felt impregnated with asphaltic base material and flexible plastic tubing, saving about 211 lb. of rubber by the conversion. A slight redesign of fairleads may eliminate 90 percent of rubber and synthetic rubber-cork composition used for this purpose. The engineers are only concerned with 11 percent of the total rubber because the gas tanks and tires account for most of the poundage. Tires will remain pure or reclaim rubber but gas tanks, after conversion, will be half synthetic and half natural rubber.

Bound hair is substituting for rubber seat cushions, arm rests and pad assemblies. It is lighter in weight and wears better. Felt is being substituted for rubber bumper pads.



QUANTITY PRODUCTION OF WORLD'S BEST FIGHTER

Part of the final assembly line at Republic Aircraft Corp. plant showing production of P-47 "Thunderbolts" designed by Alexander Kartveli, vice president and chief engineer. Already in service on American battlefronts the P-47 is considered by Army Air Forces officers to be the most powerful and fastest high altitude fighter in the skies today. It is now in limited service on various fighting fronts.



TODAY'S CARGO PLANES NOW

A conversion of the Consolidated B-24 Liberator" (left) designed for transportation of personnel or cargo rolls off the production line at Consolidated's new Southwest plant more than a month ahead of schedule It can carry a pay-load of 10 tons, has a speed of more than 300 mph and a range of 4 000 mi Coming from the longest continuously-moving straight production line in operation, its output will not curtail manufacture of "Liberator" bombers First photo released by the War Department (right), shows quantity production of Douglas C-54 Army transports These four engine cargo carriers have been rolling from assembly line for months and many are already flying vital men and materials to battle fronts

sealing strips for doors bottle holders and clamp assemblies Flexible plastic tubing is replacing rubber tubing used as a conduit

There are approximately 1100 separate parts of rubber on each P-38 and nearly 200 part numbers call for rubber or its equivalent

Bottlenecks Averted

A total of 1880 potential "bottlenecks" in warplane production was recently averted in southern California's eight major aircraft plants a result of the work of the Aircraft War Production Council Inc., it was stated in the monthly reports of the committee on Engineering and Standards and Material In June there were 1557 exchanges in material, 132 engineering reports and 171 library references to technical reports

Exchanges of engineering reports include adhesion of Neoprene to Plexiglas, air sealing of single row screw seams molded plastic cockpit and gunner's enclosures and others

Heat Equipment Mekers Merge

Merger of the Airmax Corp., formerly of San Diego Calif., and the Pacific Gas Radiator Co., Huntington Park Calif., under the new name of Pacific-Airmax Corp is announced by R C Gross and Mrs Helen A. Hartfield, presidents respectively of the companies now united Both firms were engaged in war production, the Airmax Corp, in the manufacture of airplane heating equipment and the Radiator company in manufacture of home and industrial heating and ventilating equipment Mrs Hartfield is president of the new firm and Mr Gross is vice-president and general manager A A. Arnhym, is chief engineer Helsen A Wilke is secretary and treasurer L M Hull is sales manager, J B Marchand is purchasing agent, and E M Rahm is works manager

New Douglas Bomber Plant Opened In Southwest

Douglas Aircraft Company has accepted a "giant factory" from the United States Army Engineers Nearly a mile in length this new plant, in a southwestern city, is among the largest airplane production units in the world, the company says, and will turn out four-engine planes as well as single engine dive bombers

Donald Douglas president of the company, in making the acceptance address said that "great planes and even greater transport giants are either flying or under way These huge airplanes will give

PRODUCTION BATTLE CITATIONS

Labor Day took on added significance at both the West and Southwest plants of **North American Aviation Inc.**, when the builders of the B-25, P-51 and combat trainers for both services were notified that the joint Army-Navy "E" had been awarded them.

Leeds & Northrup Co employees joined the ranks of those entitled to wear the "E" pins signifying that their organization had been selected for the joint Army-Navy award.

Lieut. Comdr R W Rose USNR, presented the flag symbolizing the joint Army-Navy production award to **Handy & Harman** company officials for high achievement in production of war equipment.

Under Secretary of War Robert P Patterson presented the Army-Navy "E" award to Harvey Firestone, Jr., marking the second such award to **Firestone Tire & Rubber Co** within a week. The first was made to its Eastern war products subsidiary

The Bullard Co., machine tool manufacturer now flies the Army-Navy "E" pennant and its employees wear the pins as a result of the award for outstanding production achievements

Brig Gen A A **Farmer**, commanding officer, Philadelphia Signal Depot, awarded the Army-Navy "E" burgee to officials and employees of the **Henry L. Crowley & Co. Inc.**

Carl L Norden, Inc., makers of America's famed precision bombsight, received the Army-Navy "E" burgee with a star, marking it as the second award, regarding which Adm H A Wiley said, "By being selected for this honor a second time you have demonstrated that yours is no half-hearted, flash-in-the-pan effort but rather a solid determination to supply the Navy with the materials it must have to carry the engagement to the enemy It is the spirit that will win this war"

Also awarded the burgee with star was the **Kropp Forge Co.** It was received without ceremony for, as Roy A Kropp, president said, "We are too busy turning out forgings for the Army and Navy to stop for ceremonies"

Jake Sparling, 60, and his assistant, Percy Fogelsonger, 75 are the entire staff of a Michigan plant where they have been working for 18 months 15 hours a day, 7 days a week and have turned out 12 000 steel flanges for war machinery It won them the recognition and flag they sought via the White House

Cessna Aircraft Co. has won the Class "A" approval of the U S Army Air Forces for the quality control exercised by its inspection department

Boeing Flying Fortress workers men and women, are first group in the entire aircraft industry to earn both the U S Treasury Department's Bullseye and Minute Man flags for War Bond purchases on a standard payroll savings plan, they report

Sperry Gyroscope Company received the joint Army-Navy "E" Award for excellence in production Presentation of the pennant was made to R E Gillmor, president Employees received the "E" pin

Curtiss-Wright Plants 1 and 2 have been awarded the Army-Navy award for outstanding achievement in the production of war equipment. "E" pennants were awarded to the plant and pins for employees

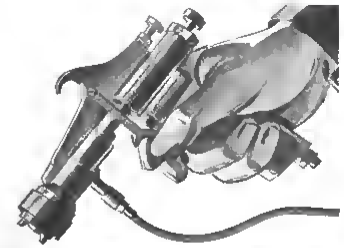
Goodyear Tire & Rubber Co received the Army-Navy "E" for outstanding accomplishments in war production Presentation was made by Maj Gen William N Porter, chief of the Chemical Warfare Service in Washington

North American Aviation's West and Southwest plants have both received the joint Army-Navy "E"

Vultee Aircraft Inc., now flies the joint Army-Navy award pennant and the employees are wearing the "E" pins

Weston Electrical Instrument Corporation also received the twin-service award for outstanding production achievements

Safe Convoy...





From production line to combat line, Lowe Brothers wartime finishes are providing safe convoy for war weapons and materials of every type against the hazards of exposure, temperature and transport

Lowe Brothers experience in supplying U. S Government Specification Finishes, as adopted by all branches of our Armed Forces, can be greatly helpful to you in finishing war weapons or materiel.

Just as Lowe Brothers cooperated to stabilize the color and performance of Machine Tool Finishes, which become the recognized standard of an exacting industry, we will gladly cooperate with you.

So why not benefit by Lowe Brothers experience with industrial finishes for peacetime and wartime products by calling upon us for information regarding application data, thinning ratios, drying schedules, bids or costs on Government Specification Finishes.



INDUSTRIAL SALES
THE LOWE BROTHERS CO.
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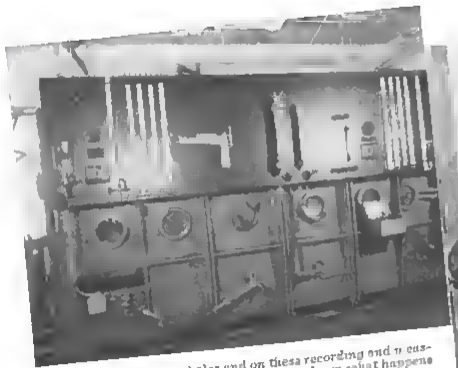
Lowe Brothers
WARTIME FINISHES for Industry

IN ACCORDANCE WITH U.S.GOVERNMENT SPECIFICATIONS

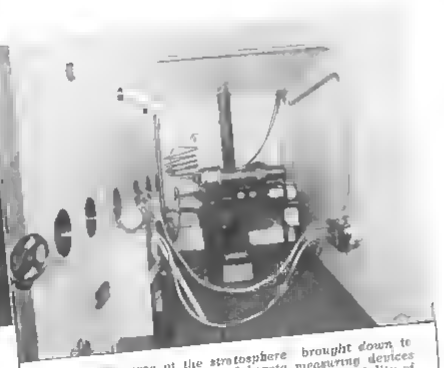


AND MAINTENANCE PAINTS
TO MULTIPLY YOUR MAN POWER EFFICIENCY

WE MUST KNOW HOW SOUTH WIND HEATERS Will Perform At 15,000 - 30,000 - 45,000 Feet!



Through these port-holes and on these recording and measuring devices, our laboratory engineers learn what happens when South Wind Heaters are put through their paces under high altitude conditions.



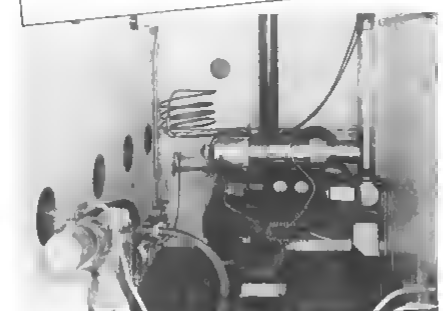
Here in a piece of the stratosphere brought down to ground level sensitive and elaborate measuring devices which could not be taken aloft prove the serviceability of South Wind Heaters.

FACTS Are More Important than THEORIES, in Our Book!

STEWART-WARNER South Wind Heaters for aircraft have behind them the best of engineering skill, the finest of theory. But their role is vital. Theory is not enough. They must demonstrate PROVEN PERFORMANCE before they are released for use in combat, bomber and other planes of our country's air forces.

How to prove performance? Take it up and see if it works? Not so simple as that! Planes are needed for other jobs. And elaborate recording and measuring equipment is bulky. Furthermore, the testing must be done under controlled conditions—difficult to do aloft.

So in order to make the final flight test merely a routine check-up, we brought the stratosphere down to the heater. We designed and built the altitude chamber pictured here. It simulates altitudes beyond the capabilities of any plane, . . . altitude pressures encountered at 15,000—30,000—45,000 feet and beyond. So now we KNOW what these heaters will do—such as the heater which operates *without supercharging at 48,000 feet!* Theory said "yes,"—and the altitude chamber *proved it!*



Heat transfer coefficients, heat output, ability to keep fuels and equipment at maximum-efficiency temperature under varying altitude conditions—these are vital questions answered by the altitude chamber.

This chamber and its accessory instruments are typical of the care and equipment which produce and prove Stewart Warner South Wind Hermetic Combustion Heaters!

ARMY NAVY

Another Product of STEWART WARNER

South Wind HERMETIC COMBUSTION Heaters

REG. U. S. PAT. OFF.

HEATER DIVISION, STEWART-WARNER CORP., CHICAGO

West Coast Office: Stewart Warner Aircraft Heater Engineering and Service, 1273 Westwood Blvd., West Los Angeles, California

the United States Army a mobility it has never before known. Before long we will darken the skies with combat transports making no battle-front too distant and no aggressor secure no matter how far from our shores."

ASSEMBLY LINES . . . By Dorsey Adams

Interchangeability of propeller parts built by Hamilton Standard and its licensee Nash-Kelvinator, was demonstrated recently by a rigid test. Two complete propeller assemblies of the basic model in production by Nash-Kelvinator, were chosen at random and shipped to Hamilton Standard. Similar assemblies were drawn out of Hamilton's finished stores. All assemblies were torn down, and two new assemblies created from parts carefully selected in a way to cause Hamilton-built parts to mate in every case possible, with those built by its licensee. Each rigid requirement was met without difficulty.

The plants of Brewster Aeronautical Corp., which was taken over by the Navy temporarily last spring for alleged failure to produce enough planes are now turning out new types of dive bombers, some of which already have been shipped abroad. *Bermuda* type dive bombers for the British were the first to be shipped. Brewster also is manufacturing a *Bermuda* prototype for the Netherlands East Indies and a *Buccaneer* dive bomber of similar design for the U. S. Navy. *Bermudas* are for land base operations. *Buccaneers* are designed for carrier operations. Both are mid-wing two-seat monoplanes powered by Wright radial engines.

X-ray in the template department is being used by North American to speed planes from the drawing board stage to the flight ramp. First step is to treat a piece of metal with fluorescent lacquer and scribe a design on the sheet. When completed, it is sent to the template X-ray room, placed over a piece of metal to activate the fluorescent lacquer and then is put into a vacuum printer. The glow from this original plate transfers the lines to a second plate, which has been coated with lacquer and transfer film, to make the negative which is developed. Negatives are filed so copies can be made at any time.

Electric heating pad, in an over-sized version, has been developed at the Glenn L. Martin Co. to eliminate the hitherto unavoidable wrinkling and buckling of the skins of wing structures while undergoing riveting. To overcome this interference with the smooth flow of air over and under the wing, "heat therapy" was applied to first expand and then shrink the aluminum sheets. Sheets are riveted together over a wood frame shaped like a wing. The heater, which fits snugly over the structure, is applied. Enough heat is given to eliminate all wrinkles. While rheostats hold the temperature constant the skin is quickly stitch-riveted around the edges and along ribs. When the heat is removed, the skin shrinks taut, unwrinkled.

A new development in finish for plywood planes and gliders is announced by Zapon Division, Atlas Powder Co. The finish, it is said, provides highest moisture resistance, and adds a minimum of excess weight to planes and fits into high speed production schedules. Meanwhile U. S. Plywood Corp., has developed a new plywood impregnated with phenolic resin which is said to be stronger and more fire-retardant than regular resin-bonded plywood. Designated as Impreg Weldwood. It is resin bonded like the earlier types but differs in that it is made by thoroughly impregnating both sides of the veneer layers with phenolic resin.

Practice bombs, used in training bombardiers, are made of thin sheet steel shells and filled with 65 lb. of sand and a 3-lb. charge of black powder to make an explosion for observation purposes.

The suggestion box maintained by Cessna has turned up one idea which alone has more than paid for the cost of installing and operating the campaign. It was a method for fabricating pulley brackets through a stamping and folding process instead of the welding method formerly used. The new process eliminates four welds, two "spot-facing" operations, bookkeeping, stocking and handling on two parts and has cut the number of rejects. A per-plane saving of about $20 has resulted from the idea.

Price increases on two grades of aircraft fir, vitally needed in the war effort, have been authorized by OPA upon request of the Lend-Lease Administration and the British Purchasing Commission. At the same time, OPA established a maximum price for a new Y grade of aircraft fir specifications for which had been drawn up by the Procurement Division, U. S. Treasury.

Transportation of war workers has been attacked with record-breaking success at the Glenn L. Martin Co. More passengers per car are carried to the Martin plant than to any other war industry they say. Last October each car was carrying 2.6 passengers. Today each car carries 4.5 passengers—a record increase in automobile utilization.

Over 7,500 women are employed by the whole Glenn L. Martin Company with over 5,000 busy on actual production and assembly of planes. At the rate of 500 a week recruits of all ages walk up to machines and drafting boards. The women get the same rate of pay as men, spend the same number of hours on the same jobs and are expected to produce the same results. The only two women in a night class of 25 Martin engineers walked away with the two highest marks. They aspire to be aerodynamists.

Substitution of phosphoric and chromic acid for the commonly used hydro-fluoric acid in the cleaning of sheet metal to be spotwelded has not only resulted in a cleaner brighter surface but has also helped step up production of *Flying Fortresses* and Vega *Ventura* bombers. Under the system previously used, the tendency of the aluminum sheet to alloy with the copper tip of the spotwelder has necessitated the cleaning of the tip after every ten or 15 spots. Vega states that when using a combination of phosphoric and chromic acid the tips do not have to be cleaned oftener than every 500 or 600 spots.

Sperry in Consent Decree

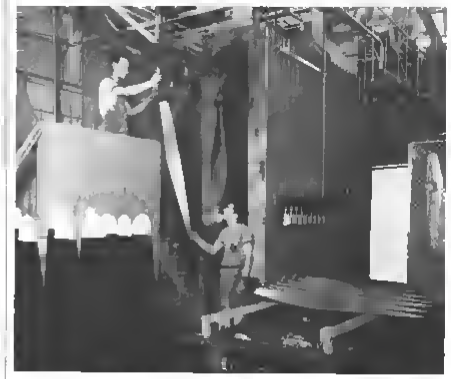
The Department of Justice filed a complaint against the Sperry Corporation, Sperry Gyroscope and London affiliate, charging violation of the Sherman anti-trust law by restraining trade in the directional gyro, the artificial horizon, and the automatic pilot. A consent decree enjoining Sperry from further violation was entered.

R. E. Gillmor, Sperry Gyroscope president said his company, in its consent to the decree, does not admit the correctness of the government's contentions. If any artificial prices were created they were not effective in the United States, he said.

Sperry officials told AVIATION that if any American manufacturer can make advantageous use of German patents in this country, they will not stand in the way. They pointed out that Sperry is letting other companies build one and a half billion dollars of Sperry products without any royalties. They said that Sperry has no time now to spend on litigation.

Sealed Power Expands

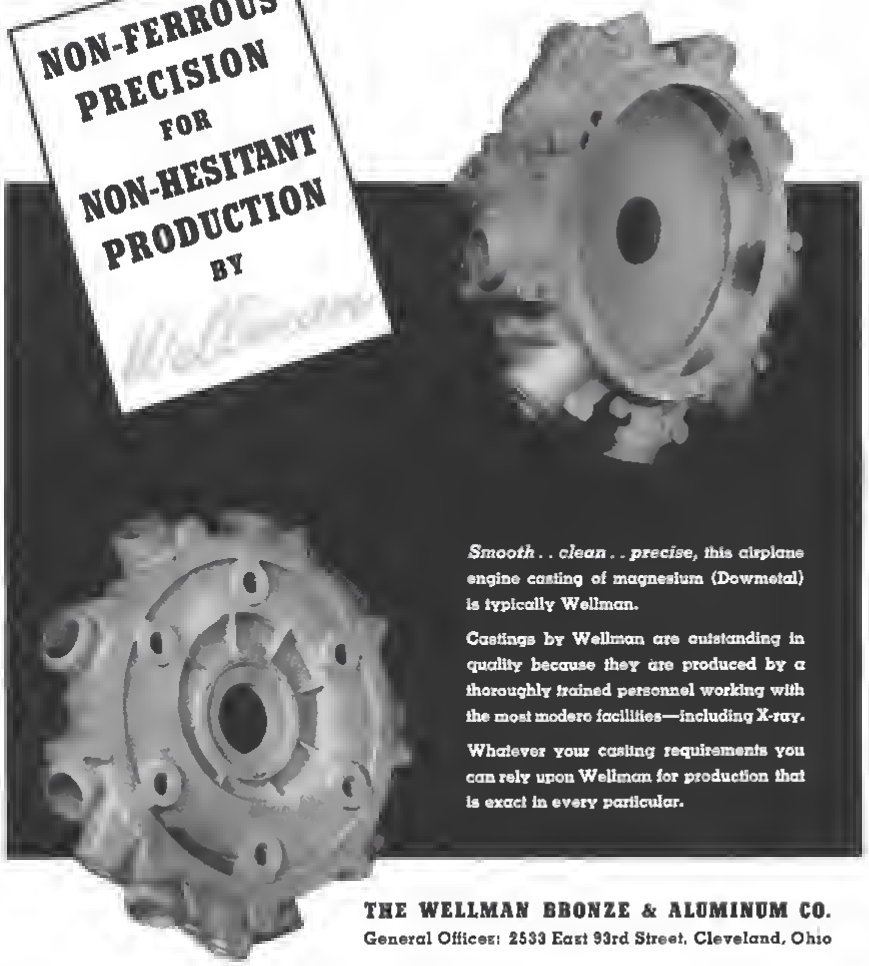
Sealed Power Corp. is now expanding its facilities for production of piston rings to meet substantial government contracts.



CONVEYOR AIDS PROPELLER CONVERSION

Wartime flying has required difficult finish painting of all propeller blades to reduce visibility, adding another problem to manufacturers. It was solved at Hamilton Standard Division of United Aircraft Corp. by installation of endless belt conveyor which carries propellers through chambers in which they are cleaned, dried and cooled, given a priming coat, again dried, painted with the final coat including the tips, and dried again. Six men operate the system which trains out a blade a minute.

NON-FERROUS PRECISION FOR NON-HESITANT PRODUCTION BY Wellman



Smooth . . clean . . precise, this airplane engine casting of magnesium (Dowmetal) is typically Wellman.

Castings by Wellman are outstanding in quality because they are produced by a thoroughly trained personnel working with the most modern facilities—including X-ray.

Whatever your casting requirements you can rely upon Wellman for production that is exact in every particular.

THE WELLMAN BRONZE & ALUMINUM CO.
General Offices: 2533 East 93rd Street, Cleveland, Ohio

• CASTINGS IN BRASS, BRONZE, HEAT TREATED ALUMINUM AND MAGNESIUM (DOWMETAL)

Wellman MEANS Well-CAST

Airline Load Factors Up; Top 90 Percent in Places

An outstanding effect of war traffic pressure on the airlines is the increased passenger load factor The airlines as a whole are operating at around 75 percent whereas the ceiling generally regarded as practical before the war was 65 percent Going higher than that, it was felt offended too many people by leaving them on the ground

Some routes in concentrated industrial areas are operating as high as 95 percent For example Penn-Central has an average of 80 percent on its system with 87 percent on the Detroit-Norfolk run Out of Norfolk, 93 percent of the seats are occupied United Air Lines is averaging 85 to 90 percent United's traffic along the West Coast sometimes runs close to 100 percent

Three main measures have been taken by the major lines to make these high percentages possible (1) All sleepers have been cut out thus providing seven to nine more seats per plane (2) Most long non-stop runs have been eliminated, giving more capacity by eliminating big loads of gasoline and making it possible to pile on the cargo without having to empty the seats (3) The "turnaround" has been stepped up That is, instead of parking planes around the field waiting for the popular morning and evening departure hours, maintenance departments service and put them in the air immediately

As Harold Crary, president of United said, people are "flying around the clock" They have to get there and they will go at three in the afternoon or three in the morning

It might be supposed that this new high load factor would hang over after the war, but transport men don't think so They believe that people will go right back to their old popular departure hours It costs more to fly the public that way but actually peacetime will find the volume of air travel so increased in volume, the planes so much bigger and operating methods so improved, that the fares may be lower than ever

Now, though the load factor is away up, and fewer planes are carrying more traffic, the standard of maintenance throughout the system is very high Draft boards are exempting airline maintenance men and the men themselves are staying, because they feel that their permanent jobs are worth more than a temporary increase on some temporary war project Service on the airlines is just as important militarily as building planes or flying them in combat.

CAB Adjusts Mail Rates

Allowing 15 days for a reply, CAB ordered Pan American Airways, Inc to show cause why its present mail rates between New York-Europe and New York-Bermuda should not be reduced to 44 mills per pound mile. The proposed rates would be retroactive to last Dec 13, and the company would have to refund excessive charges on mail since that date A reduction has already been made by CAB in mail rates payable to Pan American over that carrier's Latin-American Divisions New rates have been established over its trans-Pacific routes in operation prior to Pearl Harbor

CAB cut base rate of government payments to Pan American Grace Airways for its Latin American air mail service effective retroactive to July 1 About $1 375 000 of the airline's profits during the last 13 years was found by CAB to be excessive Profits will not be recaptured at the present time

On Northeast Airlines' route 27, CAB has determined the new rate of compensation for mail service

Braniff Airways Inc., was granted increased air mail compensation over its three routes

Parts Priority Raised

Preference rating for materials necessary for maintenance and repair of airline planes was raised by the WPB from A-1-j to A-1-a In Amendment No 2 to Preference Rating Order P-47 All aircraft production currently is assigned AA-1 rating Since airlines must acquire repair parts and maintenance material from manufacturers whose schedules are almost entirely in this category it was necessary to raise the rating to assure reasonable deliveries

Hand operated tools especially designed for manufacture repair or maintenance of aircraft military vehicles and other predominately military equipment have been placed under the provisions of Maximum Price Regulation No 136 as amended (Machines and Parts and Machinery Services) OPA announced

Air Transport Manpower Committee Set Up By ODT

An Air Transport Manpower Committee has been set up by ODT's Division of Transport Personnel Col Edgar S Gorrell president of the Air Transport Association is chairman Other members include Samuel J Solomon and Robert McCraith both directors

At its first meeting, the committee concluded That requirements of air cargo service are growing so rapidly that existing supplies of workers competent for such service soon will be wholly inadequate, that steps should be taken to begin the training of future personnel by the U S government, that women comprise one of the largest sources for required personnel



MEDICINE DELIVERED BY AIR

Second of two shipments of sulfadiazine totaling 300 000 doses reaches Santiago Chile, via Pan American Grace Airways in answer to urgent appeal resulting from meningitis epidemic in state of Los Andes which quickly exhausted local supplies American State Department and Red Cross cooperated in facilitating movement of the drug so that delivery was made in Santiago in little over three days after receipt of wire in Washington On hand to receive shipment were, left to right Vicente Salsilli, Panagra traffic manager, Dr Jose Donoso, chief of Prophylatic Bureau of Chilean Health Office, Dr Eugenio Suarez, Chilean Director General of Health and Dr John Janney, representative in Chile of Rockefeller Foundation

TWA Gets New Mail Route

Transcontinental & Western Air has begun air mail service over the Cincinnati-Detroit portion of the former Marquette route The route, purchased last year from Marquette Airlines has been designated as AM-58 TWA operates two daily round-trip flights with stops at Dayton and Toledo Previously service has been limited to passengers and air express

New Air Transport Heads

At the annual meeting of the Air Transport Association of America the following directors were elected for the coming year W A Patterson United, Jack Frye, TWA, E V Rickenbacker, Eastern, O M Mosier, American, G T Baker National, J W Miller, Mid-Continent, and Croll Hunter, Northwest

C E Woolman, Delta Airlines, was elected vice-president

CAB to Consider New Latin American Routes

The Civil Aeronautics Board has instituted a proceeding to determine whether the public interest requires immediate inauguration of temporary air transportation by United States or foreign air carriers between Miami, Florida, Central America the Canal Zone, the North Coast of South America, and the Caribbean islands

Due to the war a serious shortage of air transportation appears to exist in the Caribbean area and such a condition may adversely affect the war effort.

The Board stated that anyone with suitable equipment, facilities, and personnel available to enable it to inaugurate temporary air transportation service immediately may file with the board an application for a temporary certificate of public convenience and necessity or temporary foreign air carrier permit authorizing it to engage in such transportation Applicants should specify the equipment available

Look to HAZARD LAY-SET
for modern, precise controls . . . .



★ The Hazard organization has a virile backlog of aircraft experience that right now is proving of tremendous value to the industry. From the very beginning we were pointed to the manufacture of more *precise* controls.

Hazard was the first under license to manufacture Preformed Tinned or Galvanized Aircraft Cable and Strand—Hazard LAY SET Hazard originated KORŌDLESS (corrosion-resisting) Preformed aircraft cable and strand. Hazard plants supply complete aircraft assemblies. Into those few sentences is compressed a story of years of close cooperation with Army, Navy, and civilian aircraft engineers—and, certainly, appreciation for current problems.

Ask your nearest Hazard office for information on Hazard LAY SET Preformed Tinned or Galvanized Control Cable and Strand, KORŌDLESS Preformed Control Cable and Strand, TRU LOC Swaged Type Terminals and complete aircraft assemblies that can be made to your exact specifications.

HAZARD WIRE ROPE DIVISION

DETROIT, FT. WORTH, LOS ANGELES, NEW YORK, SAN FRANCISCO, WICHITA

AMERICAN CHAIN & CABLE COMPANY, INC., BRIDGEPORT, CONNECTICUT



P-39 AIRACOBRA
the famed interceptor pursuit ship produced by Bell

Help Them Win...Turn in Your SCRAP!



Scrap is steel or iron useless in its existing form but valuable as *raw material* for remelting. Since it is already refined, more scrap in the furnace charge speeds up the refining process and enables steel to be turned out faster for implements of war. . . More scrap—*from your plant*—means more steel

Conservation Authorities Recommend the Following 8 Steps

1. Put some one individual in charge of scrap in all departments of your business and GIVE HIM AUTHORITY TO ACT.

2. Comb the plant and yards for dormant scrap. Abandoned equipment, old boilers, pipe, moulds, obsolete dies and parts, material now being destroyed which has salvage value.

3. Survey all plant equipment, particularly idle standby or discarded machines, with a view to applying or converting them to useful production.

4. SEGREGATION: Identify, classify and segregate scrap and supervise its handling to avoid contamination. This will increase its value. Provide separate containers, clearly marked for each class of scrap material.

Repair or rework worn or broken cutting tools. Keep unusable small pieces and turnings segregated. Even high speed steel grinding dust is valuable.

Dismantle discarded equipment promptly into its components—electrical, fastenings, lumber, etc.—so that these parts may be utilized or scrapped.

Sort blanks, short ends, cut-downs, clippings, etc., for possible reuse for smaller parts made in the same or other departments.

Recover and reclaim used cutting oils, lubricants, sor plus paints and spray finishes.

Sort sweepings and miscellaneous waste to recover scrap values.

5. Constant reminders in the form of posters, illustrations of right and wrong methods, pay envelope enclosures, house organ publicity, etc., are potent aids to the conservation program.

6. Release for scrap, obsolete engravings, electrotypes and standing types for catalogs, forms and advertising material.

7. Inspect all refuse to detect overdoable waste and excessive rejections. Educate production executives to correct such conditions at the source.

8. Get information and assistance on special phases of conservation and salvage communicate with Industrial Salvage Section, Conservation Division, War Production Board, 9th Floor, Washington Gas Light Building, Washington, D. C., or with nearest regional office.

The metallurgical experience of our technical staff is available to aid you in these and other technical phases of metal salvage.

KEEP SCRAP MOVING INTO WAR PRODUCTION!

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.



Safe landings through the eyes of science

There was a time
When a tired pilot
Coming in from a rough mission
Would go white around the gills
When he spotted ground fog

Ground fog, covering the home field
With a sea of milk
Broken by islands of hills and tree-tops
Signs of the good earth
Yet for him portents of disaster

Today U S airmen can smile
When the home field
Is hid in a blur of mist—
For a voice in their earphones
Tells them to *come in on instrument*

And one by one the planes
Glide in to a smooth landing
As if each pilot had full view
Of the runway below

Modern radio equipment
For instrument landings
Is designed, developed
And manufactured
By I T & T associate companies

The broad peacetime experience
Of I T & T
In the field of communications
Is proving its value
In time of war

International Telephone and Telegraph Corporation *67 Broad St, New York N Y*

IT&T

Associate Manufacturing Companies in the United States
International Telephone & Radio Manufacturing Corporation
Federal Telegraph Company

As Some Others See Us

Rather remarkable is the lament in a Swiss publication recently received here which publishes an article concerning South American airlines that is not exactly complimentary to this country The article starts out with the remark that what the Germans, French and Italians have built up over many years with heavy sacrifices in men, money and time for the establishment of commercial services is lost to them today It then proceeds to analyze developments without apparently having any actual news since the beginning of the year

On the whole the whole story is highly damaging to American prestige and generally ignores the efforts of the domestic airlines in South America which tried to build up a domestic network in the face of nearly overwhelming competition from the heavily subsidized German Italian and French lines The fact that both Pan American and Pan American Grace were doing a first class job for many years with a type of operations which was generally foreign to American operators is also forgotten The only mention they get is the remark that they were only able to establish themselves when Axis 'spyiines were eliminated The direct contrast between American and Axis services cannot be emphasized enough—the Axis companies flew only where they felt it would eventually have military value and had unlimited funds to enable them to operate these services and get the necessary franchises On the other hand the American lines had to maintain themselves with the revenues of their services and for this reason could not maintain routes where passengers mail and express were not forthcoming

When the various South American countries took action to eliminate the Axis lines from their territory after flagrant violations of local laws the domestic lines were at last in a position to establish themselves along routes which might enable them to become self-sufficient in not too long a period. The information that none of the domestic South American companies have been able to establish themselves in the face of the ruthless expansion of American interests is disproven easily by existing airlines

In fact as this Swiss publication wishes its readers to see it the South American countries only took these steps reluctantly forced into it by the United States In so doing the publication continues one of the main pillars of South American commercial air services was eliminated aerial communications were disrupted and contracts broken left and right leaving hundreds of foreign personnel jobless and pay-less

The publication which has a wide distribution in and outside Europe also started the story about the serious friction between American and British pilots and other personnel in Africa when the ferry lines were established and its attitude, supposedly neutral has on the whole had a strong anti-American tinge for some time

New German Dive Bomber

Details have been released about the new German level and dive bomber the Dornier Do-217 which is equipped with a rather unique diving brake in the form of two or four flaps which open up from the abnormally long and pointed tail It is said that this innovation assists in controlling the plane during dives when it opens up like an umbrella

The powerplant consists of two 1,600 hp BMW-801 type 14 cylinder radials, the same as used in the new FW-190 equipped with cooling fans and installed in very deep and narrow cowlings Armament consists of a number of 15 mm cannon and 0.3 guns installed in the fuselage in turrets in the nose and on top of the control cabin The plane is said to be well armored and can carry a maximum of 6,800 lb of bombs With a gross weight of 32 700 lb the top speed is around 275 mph with full bomb load service ceiling 22,500 ft. and range 1 000 mi Without bombs the top speed is 325 mph and the ceiling 29 000 ft

French Developments

Quite a number of new airplanes are in development in France some of which are already under construction with others still in the day-dreaming stage Notable is the fact that most new designs feature the contra-rotating propellers and many different versions are being studied in the windtunnels which are still available in France

Of the airplanes now building the following types are interesting the government is building the VG-50 a twin-engined high speed plane with two new Hispanos of 1,500 hp The pilot is seated between the engines an arrangement already seen in the Fokker D-23 and in earlier Italian Schneider Cup racers The wingloading is around 45 lb sq ft which promises a high speed and difficult landing characteristics No extra-lift devices are known to be incorporated Designs have been completed for a 25 ton, four-engined flying boat with contra-rotating propellers pressure cabin and a speed of 300 mph at 30 000 ft



British Combine

DESTINATION DIEPPE

RAF pilot gives thumbs up signal as he prepares to take off in Douglas A 20 to join huge air battle which accompanied Commando raid on Dieppe. Note how nose of this American built ship bristles with armament two machine guns built into the fuselage and extra guns apparently of larger caliber set in fairing just outside bombardier's compartment.

The most fantastic plans are being developed at the Breguet plant, where work is being completed on designs for an 82-ton flying boat with eight 2 000 hp engines mounted in tandem with contra-rotating props Breguet also visualizes flying boats of from 250 to 550 tons for which a 3,000 hp engine is now being developed Another item appears to be a gas turbine the installation of which is said to have been completed and the airplane will soon be flying There have been quite a few gas-turbines in development, and while some of them have reached the practical stage they always have failed under actual flight conditions

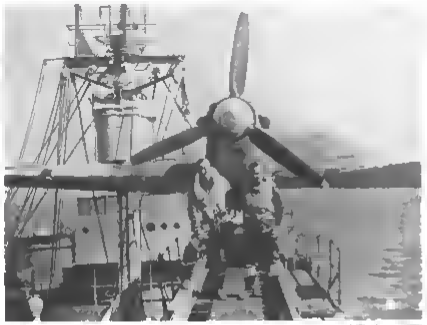
Under actual construction at Breguet is the Breguet 500 a 23 passenger, twin-engined airplane, which apparently is a copy of the Curtiss CW-20 and the Breguet 730 a four-engined high seas patrol bomber which was designed in 1935 The prototype of this plane flew in 1938 but had so many inherently bad characteristics that the design was dropped till now

Canadian News

By James Montagnes

One of the largest and finest airports in Canada is now being completed at the plant of de Havilland Aircraft of Canada Ltd in Ontario it is announced by the Department of Munitions and Supply, Ottawa When completed the runways will be more than two miles long and will cover an area greater than that of 15 miles standard surfaced highway The plant airport boasts enough drainpipes in its 270 acres to provide for a good-sized town Because the maintenance staff works night and day to keep the whole area free of snow even in the worst of blizzards, on three occasions last winter the field was the only one in its district available for the use of military and commercial airplanes The plant is understood to be producing or starting production soon on a twin-engine fighter plane

The first of the four-engine Avro *Lancaster* bombers to be seen in Canada arrived during the end of August at Montreal and was flown with its trans-Atlantic crew to Toronto where similar ships are soon to be turned off the production line at a National Steel Car Corp plant in Ontario The plane was sent to Canada so plant engineers could study it in relation to the craft soon to be in production



CONVOY GUARDIANS

Fighter protection for convoys against long range German bombers is [illegible] catapult the pilot is really on his own for, after engaging enemy, he must make way to nearest land base or, if fuel is low, bale out and hope to be picked up by an escort ship. Plane, of course, is lost, but thus far ratio has been two to three bombers to every "Hurricane."

General Motors of Canada Ltd., is to manufacture warplane fuselages under subcontract from de Havilland Aircraft of Canada, it was announced at Ottawa. The work will be undertaken at one of the company's plants where the necessary rearrangement of facilities has started. Production is expected to start in January or February of next year. The new program will involve the employment of a large number of workers, many of whom will be women. Canadian motor car companies to date have been mainly building motor vehicles for the armed services as well as certain types of universal carriers with caterpillar tread. Little aviation work has been done by the Canadian motor car makers.

Canadian furniture companies are also being put more and more into aircraft manufacturing work, due to the increasing metal shortages and the greater use of plywood. A survey of the industry with a view to fuller production of aircraft assemblies was made in August by the government.

The Royal Canadian Air Force is to have 40 squadrons operating in Great Britain by year-end. Air Minister C. G. Power announced at Ottawa on September 4, after returning from an inspection trip in Great Britain. Canada now has 25 squadrons overseas. A bomber unit of from 10 to 20 squadrons is to be established by year-end, and a fighter group is to be formed later. The RCAF is to operate as a Canadian group, not as unrecognized cogs in the RAF, he is reported to have said. Canada has 2,000 RCAF men in the Middle East and a squadron in Ceylon. The bomber and fighter squadrons are to continue operating under the RAF tactical command.

Magnesium production under newly developed Canadian processes has started. The magnesium will be used largely for aircraft and incendiary bombs. Dominion Magnesiums Ltd., is a government-financed and owned plant and will use the Pidgeon process developed by Dr. Lloyd Pidgeon in conjunction with the government's National Research Laboratory. The Pidgeon process is for extracting metallic magnesium from dolomite, a crystalline rock which abounds in Canada. The process uses a minimum of electric power.

Noorduyn Aviation Ltd., has set up new production records. Figures released show that in June 1942 the company's plant produced in excess of total production for the first 6 months of 1941. Production for the first half of 1942 exceeded that for the same period in 1941 by 275 percent. The company makes North American *Harvard* advanced trainers and the Noorduyn *Norseman* transport plane used for training Canadian and American air force radio operators.

Swedish Divebombers

Divebombers for the Swedish Air Force are being built by Svenska Aeroplan AB of Trollhattan and Linkoping. They are said to have approximately the same dimensions as the Ju-87 though the bombload is carried in the fuselage. There are no diving brakes, but the hydraulically operated landing gear is used to increase the drag of the aircraft, the landing gear fairings have been specially designed for this purpose. The airplane can be fitted with wheels, floats or skis, though in the latter case some slight adjustments are necessary to absorb the shock.

ON SCHEDULE . . . by "Vista"

Of the few privately owned airlines in Europe which have managed to maintain operations during this war Swissair has always been the outstanding example of first class operations. Once running highly popular lines from the Swiss resorts to Paris and London besides other routes to main trade centers, it has been reduced to one single run from Zurich to Berlin via Stuttgart. Still, taking this tremendous reduction into acount, the report for the past year which has just reached this country is not too bad. Revenues dropped from 1,600,000 Swiss francs to 1,320,000 Swiss francs ($393,120 to $305,900 from 1940 to 1941, and last year showed a loss of 80,200 francs ($18,800) against a small profit of 10,200 francs ($2,400) in 1940. Swissair is only using 20 percent of its fleet and sold some of the older airplanes to outside interests. The company had been operating Douglas DC-2s and DC-3s with outstanding success for some years and was one of the first companies next to the KLM and Swedish ABA to realize the value of this equipment for its high altitude operations. The company received a subsidy of 492,000 francs ($115,100) in 1941 in various forms from the Swiss government and Post Office.

The first actual cargo airline in this hemisphere was started a short while ago in South America by Pan American Grace Airways. It runs from Balboa in the Canal Zone to Lima, Peru, and was surveyed earlier in the year. Now operating with a certificate of the Civil Aeronautics Board, it is felt that this is just the beginning of large scale cargo operations all over this hemisphere. Operations at present are with two stripped-down DC-3s, but it is hoped that as loads increase larger aircraft will be available. Loads on the survey flights have run between 1½ and 2 tons per trip, consisting mainly of materials vital to the war effort.

While declarations of the CAB concerning Pan American now come under the heading of military secrets, enough is said to give some indication just what this company is accomplishing. The simple fact that rates on both the Atlantic and Pacific services were cut without recapture 'as compensation for certain uncompensated services in the North Pacific,' indicates that the airline's expansion is continuing and that loads are reaching a point where the old 'encouraging' mail rates are no longer necessary.

Danish DDL Operating

The Danish Air Lines have carried an increasing number of passengers during the past year and are on the whole satisfied with the present operations, though new aircraft seem to cause some concern. The company received a subsidy of 500,000 kroner for the past year which will be kept in reserve for the purchase of new aircraft. While the present fund available for this purpose now amounts to 3,200,000 kroner such purchase will hardly be possible before the end of the war.

Anti-Freezing Spinner

In order to prevent trouble with the operating oil in the controllable-pitch airscrew hub developed by Junkers it consists of two co-axial shells which surround the hub. Warm air fed from the engine cowling into the space between hub and inner shell flows through a forward opening into the space between the shells and leaves through slits in the outer shell. The airscrew hub is thus surrounded by two layers of warm air. The Junkers controllable Hamilton designs operated by oilpressure from a separate pitch propeller is a copy of oil pump via a governor. The Junkers system is entirely independent in its operation and wear of parts is slight.

British Box Score

Since the beginning of the war the British have destroyed 10,000 Axis planes and lost 9,500.



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YOU'LL KNOW THIS NAME BETTER

When war clouds have passed and peace-time flying brightens the skies, you will know the name JOYCE even better than you do today.

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TOW-TARGETS FOR AERIAL AND ANTI-AIRCRAFT GUNNERY · AIRCRAFT SPINNER AND PROPELLER BLADES



★ ★ ★ By RAYMOND HOADLEY ★ ★ ★

SO MUCH HAS BEEN SAID in the past year about 'profiteering" on war contracts that many people have been led to believe that industry generally has been piling up big profits on war business In many cases the profits cited have been before allowance for taxes and other necessary charges In other cases sharp increases in net income, caused by a transition from part time operations to full time operations on war contracts, have created a false impression as to true earnings

With the publication of earnings reports for the first half of 1942 evidence is now at hand as to the truth about war profits The National City Bank of New York has studied the six-months earnings reports of 125 of the largest arms contractors including aircraft, aircraft parts, steel, automobile, chemical and rubber companies The bank found that net income of these representative industries showed a gain of 16 percent as compared with the like 1941 period but before taxes After taxes, the score was found to be a decline of 36 percent in net income this year as against the corresponding six months of last year Not only are current earnings of this group substantially below 1941, but also 22 percent below even the first half of 1940 The national defense program, the reader will recall, did not get under way until June of 1940

Sales for 86 of these companies increased 10 percent (aircraft sales volume showed a spectacular gain but automobile and some other concerns were lower than a year ago) yet the margin of profit to sales declined from 7 1 to 3.8 percent. And the reserves set up for taxes this year exceeded by three to one the net income available to corporations and their stockholders for payment of dividends and for investment in working capital necessary to expand production still further Certainly the aircraft stockholder hasn't had a glimpse at these so-called war profits for most company managements have felt compelled to postpone dividend action until they could tell how much income if any there would be left to pass on to shareholders after Congress and the Treasury Department got through with the new tax measure

Last spring there was some talk around that the government might take over the airlines and run them during the war as it did the railroads and the telephone system In World War I Wall Street at that time wasn't very partial to the domestic airlines but today they are among the particular favorites in the financial district The reason is that the Air Transport Command has turned to the airlines and asked them to do one of the most important jobs in the war effort—a bigger job than most people yet realize Uncle Sam has ordered thousands of cargo planes and as they come off the assembly lines in ever increasing quantities they will be turned over to the airlines to transport munitions and personnel to all parts of the United States and to the war fronts The government-owned planes will be operated on a cost plus fixed fee basis or some similar arrangement. Present commercial schedules of the airlines will not be affected but will continue under private management. Wall Street knows now that the airlines are not going in the 'dog house' and believes their earnings outlook is favorable

★ ★ ★ ★ ★

The Aircraft Parts Manufacturers Association through Jack Frost, executive secretary has gone on record as opposed to the proposed 1942 excess profits tax on the ground that it would discourage production Most parts makers entered the field too late to take advantage of the 1936-39 base period for calculating normal earnings above which the excess profits tax applies Mr. Frost estimates that not more than 5 percent of his membership could take advantage of the base period option to determine their exemption Instead they will be forced to calculate their excess profits as those exceeding 8 percent of capital investment

As most aircraft parts makers have a comparatively modest capital—the prime plane concerns furnish them material and the parts people supply only labor machines and management—their profit is dependent upon volume Thus, under the proposed excess profits tax, they claim there will be little incentive to push production past the initial period sufficient to roll up the allowed profit

Lockheed's president, Robert E Gross is restricted by censorship from disclosing his company's sales and earnings for the first half of 1942 but he was able to give stockholders the astounding news that July production exceeded that of the entire 1940 year while operations of Lockheed and its subsidiary, Vega, in the six months ended June 30 were almost equal to deliveries in the entire two previous years, 1940 and 1941 Mr Gross also revealed that as of Sept 1, 1942 cash aggregated more than $15,000 000 and bank indebtedness had been reduced to $26,000 000 from $36 500 000 on June 30 1941 Wall Street dopesters have figured it out that on the basis of what little data Mr Gross did reveal earnings are probably running ahead of a year ago

The Lockheed management feels that a forecast of 1942 earnings, as a basis for dividend action, is impossible at this time because of tax uncertainties However, it also recognizes that annual dividend payments to stockholders are less satisfactory than smaller interim payments and hopes that conditions in 1943 will make possible the consideration of smaller cash amounts more often

Aviation Corp. has deferred dividend payments until a reasonable forecast of earnings can be made Another manufacturing unit to be known as Northern Aircraft Products division is planned with a plant to be built in Ohio for the production of aircraft parts Net profits for the six months ended May 31 after taxes amounted to $2,476 291 as compared with $552 234 in the first half of the 1941 fiscal year Earnings this year included substantial income from dividends from wholly and partly owned aircraft and shipbuilding companies along with profits realized on sale of securities.

Bendix Aviation Corp. showed larger earnings in the nine months ended June 30 than in any previous full fiscal year except the immediately preceding fiscal year Net profits were reported at $11,035,022 or $5 22 a share while the tax provision for the nine months came to the huge total of $76,232 762 The tentative financial statement did not disclose either sales or the backlog of unfilled orders It will be recalled that at the end of the 1941 fiscal year Bendix reported a backlog of $330,000,000 and that sales had soared 165 percent while taxes came to a mere $23,445 000

Pan American Airways' mail rates over Latin-American routes have been ordered slashed about $3,366 000 a year by the Civil Aeronautics Board Last year Pan American received around $6 610 000 for transporting United States mail in this area The CAB pointed out increased war traffic in express, mail and passengers was resulting in constant heavy payloads on the carrier's Latin-American divisions

Another cut in mail pay may be on the way for Pan American as CAB has ordered the line to show cause why rates now in effect on the transatlantic routes from New York to Europe and Bermuda should not be reduced The board contends that PAA operations over the Atlantic have been on a commercially self-sustaining basis since Dec 13, 1941

Sperry Corp reported net income of $2,394,237 for the six months ended June 30 equal to $1 18 a capital share as compared with earnings of $3,477 433 or $1 72 a share in like 1941 period These earnings are after provision for renegotiation of contracts reserves for post-war contingencies and an over-all federal tax rate of approximately 80 percent

Fairchild Aviation, like Sperry Corp., has deducted nearly 80 percent of 1942 earnings to cover federal taxes Profits for the six months ended June 30 were $2,118 750 before taxes and totaled $365 049 after taxes had been deducted

American Aviation Corp. has been organized to provide plywood planes and gliders on a mass production basis for the Navy by using the facilities of a group of furniture manufacturers, according to an announcement by R. N Webster, president and chairman of the new concern An especially designed assembly plant will be completed about the first of the year in upstate New York and substantial contracts already have been received

Regularly scheduled air express service in the United States celebrated its fifteenth birthday last month In the first full year of operation 17,000 shipments were carried In the first six months of 1942 more than 877,000 shipments, weighing 4,330 tons, were flown by the domestic airlines. A 5-lb package from Boston to San Francisco

Comfortization



TO STEP UP PERFORMANCE WHEREVER PHYSICAL LIMITS ARE STRAINED!

IN THE AIR, in the factory, in the home—wherever the Fight for Freedom imposes new and greater limits on human performance—there PACIFIC-AIRMAX heating and conditioning equipment does its vital, timely job of increasing human efficiency through greater comfort.

PACIFIC-AIRMAX CORPORATION—formed through the merger of AIRMAX CORPORATION of San Diego, California, with PACIFIC GAS RADIATOR COMPANY of Huntington Park, California—now combines in one fully staffed and equipped plant complete facilities for the production of special high-altitude heating and comfortizing equipment for aircraft and a complete line of PACIFIC-AIRMAX gas heating and ventilating equipment for America's factories, training stations, cantonments and defense homes.

PACIFIC-AIRMAX engineers are developing and applying advanced design principles to wartime heating equipment that will be reflected in a new, still better and more saleable line of PACIFIC-AIRMAX equipment for peace-time uses after Victory is won.

Pacific Airmax
HUNTINGTON PARK CORPORATION CALIFORNIA

which cost $15 in 1927 is carried for $4.80 today.

Square D Co., makers of electrical equipment and aircraft precision instruments, has just completed a new plant and expects two more ready for manufacturing operations before the end of the year. Earnings for the six months ended June 30 were $767,321 or $1.71 a share on the common stock. The company earned $1,397,346 in the first six months of 1941.

ON THE RAW MATERIALS FRONT

One of the most critical shortages in aircraft's materials cupboard is steel. A plant making airplane propellers recently was unable to get certain forgings. Affected was only one small part—a tube used for oil testing—but for lack of it conveyor lines clanked along virtually devoid of finished propellers. One of the largest machine shops in the country got all tooled up this past summer to produce aircraft engine crankshafts but found little if any steel available. A large aircraft engine plant dropped from seven to five days a week for the lack of steel forgings. The fact is that the scarcity in special steels more even than the shortage in copper, magnesium or subcontract parts will be the chief limiting factor in aircraft production the rest of this year.

This is the world's first "alloy steel war." In peacetime the nickel, molybdenum, chrome, and vanadium blended steels amounted to only 7 percent of the nation's steel production; now the percentage is climbing to 20 percent of total capacity. One automobile concern for example now making air-cooled engines for planes and tanks is consuming nine times the amount of steel used in 1938.

America has 50 percent of the entire world's steel capacity—almost half as much again as at the close of World War I. More than 5,000,000 tons of alloy steels were produced in 1941 compared with 3,000,000 tons in 1939. Yet the demand today is for 15,000,000 tons. No wonder the steel shortage is so acute in the aircraft, shipbuilding, military vehicle and other armament industries.

Here are some of the reasons supply and demand are so out of line: Munitions output schedules are unbalanced. Some parts must be stored (and the materials in them temporarily lost) until the other parts of war production catch up. Some munition makers have accumulated large stockpiles of raw materials while others live from hand to mouth. Output of steel plates for shipbuilding has been pushed so hard that other types of steel suffered. Substantial tonnages of high grade steel (the supply of which was already low here) have been lend-leased to Russia. English needs for raw and semi-finished steels have been unexpectedly large.

But by the first quarter of 1943 a considerable improvement should be noted in steel supplies. That is the considered opinion of observers closely associated with the steel picture in the war production program. They attribute this coming change to two factors: a decline in war plant construction needs and the current realignment of the program to balance armament requirements of vital war industries more evenly with the available supplies of steel and other vital materials.

Contrary, perhaps, to the general impression, war plant construction has not passed its peak. In fact only $1.7 billions of the $18.5 billions of government and privately financed plant expansion had been completed by the end of 1941. However, it is understood that this program now has reached a plateau where it will remain for several more months, then slide off sharply along with a materially lessened demand for structural steel and other scarce materials.

The WPB is also taking a more realistic attitude toward raw material supplies. It has stopped the practice of "drawing blank checks" on vital materials—never knowing how many of these blank checks (priority orders) the Army and Navy had out or if there were enough raw materials available to honor them. This new control has been established by taking away the power of field offices of the Army and Navy to assign priority ratings for materials.

The steel industry will produce between 86,000,000 and 87,000,000 tons of steel this year. And for the first time WPB is insisting that the Army and Navy make their programs fit this tonnage. If the services decide they must have more steel plate, then they will have to be content with less structural or some other type steel. In this way, when the new policy is in full effect, there should be no shortages in what are considered the most essential offensive weapons. Then again, there will be more steel capacity available next year than there is today. How much more must remain a military secret for the present.



FREDERICK G. DAWSON (left), who has been appointed general manager, and **LEONARD C. MALLET** (right) assistant general manager of Pratt & Whitney mid-western engine plant. Both men have been connected with the organization for 13 years. Dawson was assistant secretary of United Aircraft and Mallet division arrangement of Pratt & Whitney.



ALBERT H. LUKE was appointed superintendent of Lewis School of Aeronautics. He was the first pilot and flight instructor the school had and has been with them since 1935.



RUDOLPH H. DEETJEN has been appointed assistant to Virtor Emanuel, president of the Aviation Corp. He has been a partner in the investment banking firm of Emanuel & Co. since 1931.



ROBERT F. SIX, Continental Air Lines president has left Tulsa to report for active flying duty with the 25th ferrying wing of the Air Transport Ferrying Command.



JOAQUIM SALGADO who, as Brazil's Air Minister has complete charge of all his country's aviation, has a job which has suddenly assumed greater importance since Brazil's entry into the war.



R. E. PFENNIG, vice-president in charge of UAL's eastern operations, is on leave of absence to serve as a major in the Air Transport Command of the Army Air Forces.



BRIG. GEN. CLAYTON L. BISSELL has been appointed commander of the U.S. AAF in China, Burma and India. His appointment will not affect Brig. Gen. Chennault's China Command.



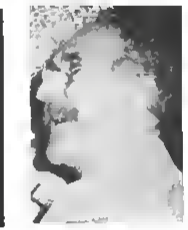
WILLIAM A. BATES has been elected vice-president in charge of all manufacturing for Brewster Aeronautical. He joined Brewster in 1938 as production manager, then became works manager. **RUSSELL VAN HORN** (right) has been formally made treasurer and director of the company. He will have supervision over financial affairs of all Brewster plants and properties.



LT. JOHN JAMES POWERS, cited by Pres. Roosevelt and awarded the Medal of Honor for demolishing one enemy gunboat, crippling another, damaging an aircraft tender, a 20,000 ton transport and sinking an aircraft carrier with a direct hit.



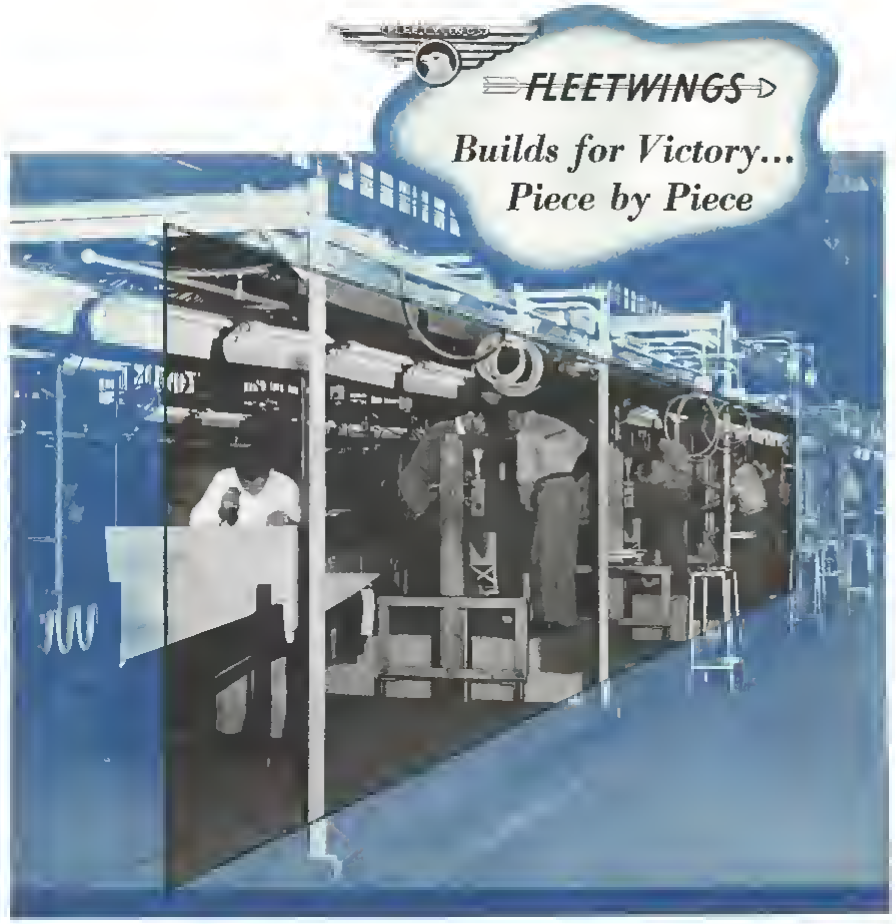
S. J. SOLOMON (left), president of Northeast Airlines Inc., has been named to head the new "Air Line War Training" program by which nation's airlines will set up large scale program to train pilots, navigators, mechanics and other personnel necessary to conduct the vastly expanded services now being operated on world-girding lines for the armed forces. His executive assistant is **JEROME C. LEDERER**, who resigned as director of the Safety Bureau, Civil Aeronautics Authority, to help on the new important job.



DR. SANFORD A. MOSS, General Electric engineer who pioneered the turbo supercharger received 70th birthday greetings from the AAF and was presented with a plaster cast of a bolt delicately inlaid with dimes as a stake in his rain-matching hobby.



BARTLEY WHITESIDE has been appointed superintendent in charge of production at Wright Aeronautical Corp. As supervisor of employee training he devised a training system for machine tool operators which aided in speeding production of horsepower.



ALONG the speeding assembly lines at Fleetwings' "attack plants" you can see the answer to the challenge flung at America—see the formation of still more of those giant air-raids that are going to put the final crimp in the Axis.

Hour by hour, finished parts for America's growing air fleet pour forth in an unending stream: fins, wings, stabilizers, flaps, ailerons, rudders, fuselage sections, tail surfaces, etc., etc.

From the hydraulics division come ever-increasing quantities of those efficient Fleetwings-designed valves and jacks to control landing gear, wing flaps, gun turrets, automatic pilots.

Piece by piece Fleetwings builds for Victory.

And after Victory? Plans for that are progressing, too. You can be sure that the streamlined technics, the new manufacturing methods, the new tools developed by Fleetwings are going to play a part in America's sky-written history.

But that's still in the future. For now, it's our first job to keep things moving, to see that today's job was done yesterday.

★

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Recent Books

BILLY MITCHELL *by Emile Gauvreau and Lester Cohen. Published by E P Dutton & Company, Inc., New York. 306 pages. $2.50*

To say there is never a dull moment in this book, even when it repeats itself, would be understatement.

Like the bombs dropped from Gen William (Billy) Mitchell's old DH planes that sank the war prize German battleship *Ostfriesland* off the Virginia Capes back in 1921, this story of Mitchell's stormy career might be characterized as TNT. Its reverberations may be more far-reaching than was the aerial bombing of the pride of the German Navy before a startle-eyed "gallery" of dignitaries. Among the spectators were foreign dignitaries including two "Honorable" Japanese gentlemen who bowed and hissed with approval.

Speaking of the *Ostfriesland* which Congress had authorized President Harding to utilize as a sea target, Gen Mitchell told his men of the Air Force, "We're going to send her to the bottom with 2,000-lb bombs, and to hell with the brass heads who want us to drop cream puffs!" All of which was characteristic of his fiery, almost single handed crusade for a gigantic American Air Force, as against stocking up on more battleships which "would be useless without aircraft to protect them as a sky blanket."

Mitchell saw clearly what others failed to see—that air power would shape America's future. Later, in the Coolidge administration, he offered to sink the Ninth Dakota before the entire House Aircraft Committee. The proposal was promptly tossed into the wastebasket.

Six years after the Armistice this country stood eighth in air power, with Poland seventh. Indeed, Mitchell's peace time "Blitz" became not only a dynamic campaign for the mightiest air armada but a fight for its unification under a single command. "If a nation ambitious for universal conquest gets off to a FLYING start in a war of the future," he said, "it may be able to control the whole world more easily than a nation has controlled a continent in the past."

It was natural that Mitchell should demand elimination of the old DH 4s, for in those "flaming coffins" airmen were frequently being burned alive—517 officers and men killed on the training fields between 1919 and 1925. President Coolidge's Aircraft Investigation Board, with Dwight W. Morrow as chairman, in 1925, reported that there was no evidence of faulty aerodynamic design of the DHs. Yet "they killed more of our flyers than the Germans did."

In books and stories of magazine articles Billy Mitchell earned his flaming message to the public, he waged war fare against the complacency of the "arm-chair admirals" and the "brass heads" of the War Department, as he called them. He predicted the attack on Pearl Harbor, the Japanese seizure of the Philippines. "These islands," he said, "would be at the mercy of squadrons of bombers." He foresaw the Japanese invasion of Alaska. It "would begin along the Aleutians and creep up! . . . Alaska is our most vulnerable spot . . . If Japan should ever get Alaska, I am convinced that North America would face the most serious menace since its discovery." In 1920 he said, "Japan is the nation to watch—later Germany."

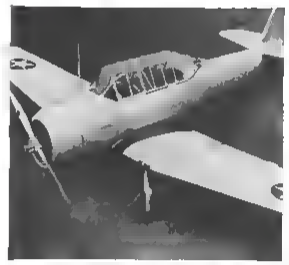
Before he died, Mitchell entrusted to Gauvreau some of his most important writings to be released "in time of national crisis." Both authors, Gauvreau and Lester Cohen knew Billy Mitchell probably better than anybody else. This book is the result of that friendship.

JANE'S ALL THE WORLD'S AIRCRAFT *compiled and edited by Leonard Bridgman. Published by The Macmillan Company, New York. 449 pages illustrated. $19.00.*

Published for the first time in America, this annual "Who's Who" of the world's aircraft, now in its 51st year and land wartime edition, is amazingly comprehensive despite war's censorship and the swift changes in aircraft design and production. It is a big lap-size volume containing more than 3,000 illustrations and scale drawings.

Four distinct sections comprise this notably definitive work. Arranged in alphabetical order of nations, each section has been almost entirely revised and rewritten and brought up to date as of Dec. 31, 1941. Part (A) is a record of the army and navy air services and of the independent air forces of all nations—Afghanistan to Yugoslavia—with an account of their organization and addresses of their various departments and commands. There is a special review of the war effort of the British Empire during 1941. Published here "for the first time is something of the history which preceded the formation on British soil of the various Free and Allied Air Forces which are now cooperating with the Royal Air Force." Diagrams of the national markings of all the world's air forces are another innovation. Likewise there is more information about the air forces of Germany, Italy and Japan than has ever before appeared in a work of this kind, thanks to captured Axis planes.

FLEETWINGS
pioneers with parts and hydraulic equipment



The BT-12, all-welded basic trainer built for the U. S. Army Air Forces

INTO THE BLUE SKY YONDER—That's the destination of this plane—the Fleetwings BT-12. Designed and built by Fleetwings, this trainer is the world's first all-welded military plane constructed principally of stainless steel. With it the U. S. Army is turning fledgling "dodos" into fighting birdmen.

AMONG THE NEW DEVELOPMENTS—announced by the Fleetwings Hydraulics Division, is a new gun turret valve which combines both lateral and elevating controls in one unit—provides a means of operating a machine-gun turret at a variable speed and lets gunners maintain continued fire on moving targets.

IN TRAINING—To the Fleetwings Vocational School goes much of the credit for the specially trained personnel that's doing so much to maintain Fleetwings' enviable ahead-of-production schedules. To date, more than 1000 men and women have been graduated from its classes and have joined the other workers on Fleetwings' production lines.

NEW FLAG—Fleetwings' members are hailing the new "Minute Men" flag awarded us by the Treasury Department. At Fleetwings, we make an *active* slogan of—

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Part (B) reviews the progress of civil aviation of all nations during 1941, gives names and addresses, in so far as possible, of aeronautical officials, departments, associations, publications, transport companies, airports, flying schools and clubs, and a list of international aircraft markings. Revealed also is the status of aviation in numerous Axis-occupied countries.

Part (C) is by far the largest section in the volume with 233 pages and 444 illustrations giving detailed information about the aircraft industries, names and addresses of factories and officials, and types of aircraft of all countries, even to India and Turkey. There are more than 100 three view drawings of the most important aircraft in service or in production during 1941.

Part (D) covers aircraft engines of all nations with photographs, many taken from different angles, and of the component parts and specifications of the more important engines.

TECHNIQUE OF PLYWOOD *by Charles B Norris. Published by I. F. Laucks, Inc., Seattle. 249 pages, illustrated. $2.50*

Calculated to be especially useful to engineers and designers who are currently drawing heavily upon the use of plywood, particularly for aircraft manufacture and for wartime housing, this handy, pocketsize book is packed with informative text, blueprint graphs, charts, tables and working formulas. The 30 odd chapters in the volume first appeared as a series in the *Hardwood Record*.

For convenient reference, its five main subdivisions deal with: "Strength, Deformation and Elastic Stability of Plywood Sheets", in which separate chapters treat panels, floors and walls; "Elastic Theory (two dimensional) of Wood and Plywood", whose last chapter, for example, discusses strength of wood at angle to grain—tensile strength of wood; "Manufacture of Plywood", including both hot and cold press processes and handling of veneers. "Warpage of Plywood" and "Bending, Moulding and Embossing of Plywood." As indicated in the preface "a great deal of work has been done in this field since these articles were first printed. In them the author has attempted to lay down a foundation for future work."

A special chapter on "Strength and Deflection of Douglas Fir Plywood under Loads Applied at Right Angles to Face" presents preliminary results of a cooperative project of the publishers and the Forest Products Laboratory. The last chapter on "General Scientific Principles of Gluing" was written by I. F. Laucks whose clear and comprehensive discussion of the basic sources of glues and the processes of compounding of wood with glue any layman could understand.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE, *published by The Lincoln Electric Company, Cleveland, Ohio. 1267 pages including reference data and index. Illustrated, $1.50 in U.S.A. $2.00 elsewhere.*

New information in the seventh edition of this handbook includes welding symbols, new allowable stresses and stress relieving, preheating, flame cutting, plug welds, procedures, speeds, and costs, automatic welding, "fleet-fillet" technique for higher welding speeds, testing machines, general metallurgical characteristics of metals and alloys, weldability of aluminum alloys, SAE steel numbering system, and tubular construction.

Descriptions of thirty nine additional applications of arc welding, graphs, diagrams, tables, and photographs make the book an up to-date supplement to other texts in the field and cover the construction alphabet from aircraft to zoos.

PRINCIPLES OF MAGNAFLUX INSPECTION *(second edition) by F. B. Doane. Published by Photopress Inc., Chicago. 288 pages, indexed.*

Changes from the first edition of this handbook on a commercial inspection method are principally the addition of new photographs, enlargement of the bibliography, and new material on detectable defects, interpretation, and welding. Beginning with an introduction on the background and advantages of the method, the succeeding chapters are on magnetism, the Magnaflux Method, magnetizing methods, magnetizing current characteristics, the inspection medium, detectable defects, non detectable defects, false indications, weld inspection, demagnetization, interpretation of indications. Aircraft inspection, which is specially treated in another volume, is not the major subject of this more general book.

A BIBLIOGRAPHY OF AVIATION MEDICINE, *by Ebbe Curtis Hoff and John Farquhar Fulton. Published by Charles C. Thomas, Springfield, Ill. $4.00.*

This unusually valuable volume, covering the world literature, was prepared for the Committee on Aviation Medicine, Division of Medical Sciences, National Research Council, acting for the Committee on Medical Research, Office of Scientific Research and Development. It contains 6,000 citations, drawn from 800 journals embracing the works of American, British, German, French, Italian, Japanese and Russian workers in this field.

The book contains 14 sections, all of

WHAT NEXT?

1903 Flying machines. Men shook their heads. "Darned fools, what won't they think of next?" Fortunately for America, her aircraft engineers and designers kept right on thinking. And now every man, woman and child is interested in "what's next" in aviation. Manufacturers and fabricators of laminated plastics, like ourselves, are interested in what's next, too, for the light weight and many advantages of Synthane and similar materials have a part in the present and the future.

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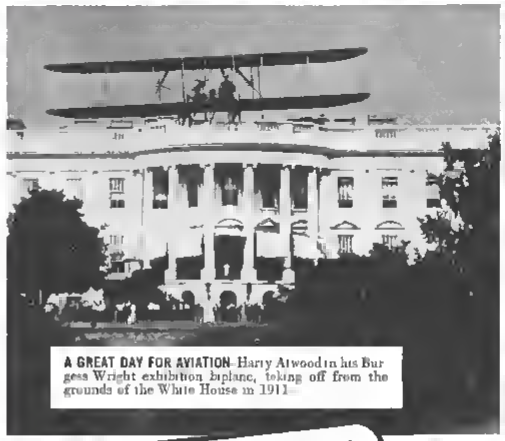


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DO YOU REMEMBER THIS? It's the famous Boeing B-1 of 1920, ancestor of the present Boeing "Clippers" of Pan American Airways trans-ocean service.

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A GREAT DAY FOR AVIATION. Harry Atwood in his Burgess Wright exhibition biplane, taking off from the grounds of the White House in 1911.



THE WILLIAMS' HELICOPTER, 1908, with Curtiss air-cooled engine, rose about three feet, but proved uncontrollable, a fault common to most early helicopters.

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AIRPLANE STRUCTURAL ANALYSIS AND DESIGN *by Ernest E Sechler and Louis G. Dunn Published by John Wiley & Sons Inc. New York. 412 pages indexes $4.00.*

Standard structural problems are mastered in this book, latest in the "Guggenheim Aeronautical Series." The emphasis is upon latest knowledge of contravesial theories which the authors hope will be investigated by other researchers.

The material drawn from lectures in ...nautical training for ...stomp of ...nautic engineers at the California Institute of Technology in 1940 is divided into three parts: designing for expected loads, methods of structural analysis, and applied stress analysis. Problems considered in the two latter parts include truss and frame analysis, ultimate strength of stiffened flat sheet, plates under normal pressure, analysis of cylindrical structures, and fuselage analysis.

PRACTICAL AIRCRAFT SHEET METAL WORK *by Russ Frazer and Orrin Berthiaume Published by John Wiley & Sons Inc. New New York. 206 pages illustrated indexed and blueprints in rear pocket $3.00*

This comprehensive text stays in its own field but leaves none of it untouched. It is intended to be completely self explanatory for purposes of home study as well as industrial or public-school instruction. The lessons, rarely more than a page or two long, are compactly laid out, stating the objective, giving the information, and ending with problems where feasible. The entire course is divided into four units: (1) on assembly from aircraft standards and elements of drills through all phases of riveting; (2) on aluminum and its alloys, steels, and aircraft nomenclature; (3) on templates and blueprints with bending theory and technique and shop geometry and trigonometry; (4) exercises in blueprint reading, with special stress on terminology and abbreviations.

The authors, both practical men as well as experienced teachers, have kept this intensive course scrupulously related to the industry in every detail.

AIRCRAFT ENGINE MAINTENANCE *by Lt James H Sudduth U.S.N.R. Published by John Wiley & Sons Inc. New York. 374 pages illustrated indexed $2.75.*

A compact, lucid explanation of the operating principles and maintenance of aircraft engines intended chiefly for student and practicing mechanics by the former maintenance engineer of Eastern Air Lines.

Beginning with simple diagrams on the theory of internal combustion engines, Lt. Sudduth describes various parts and assemblies—including carburetors, ignition and electrical systems, propellers, and accessories—gives specific instructions for maintaining engines, preparing them for flight operating them in the air, and inspecting various parts at routine intervals. This is a practical "how to" book for anyone who must keep an engine running.

BELT CONVEYORS AND BELT ELEVATORS *by Frederick V. Hetzel and Russell K. Albright Published by John Wiley and Son Inc. New York $6.00*

This is a practical book aiming to explain principles on which belt conveyors and belt elevators operate and their reasons for being. The book is primarily about types of conveyors for handling in bulk materials other than those used directly by the aircraft industry. Belt-for conveying packages and manufactured products, occasionally seen in plants doing aircraft work are given little more than passing attention.

WELDING HANDBOOK *second edition Published by American Welding Society New York 1606 pages illustrated indexed. $6.00 in the U. S. $6.50 elsewhere*

Chapter by chapter this technical volume has been prepared by committees of experts primarily to provide an up to date reference book for engineers. A textual treatment throughout however makes it available also as a text for engineering schools. This double purpose formidable as it sounds in an exhaustive technical treatise, appears to be achieved successfully by a logical sequence of material, the use of numerous, relatively short chapters, and further division of



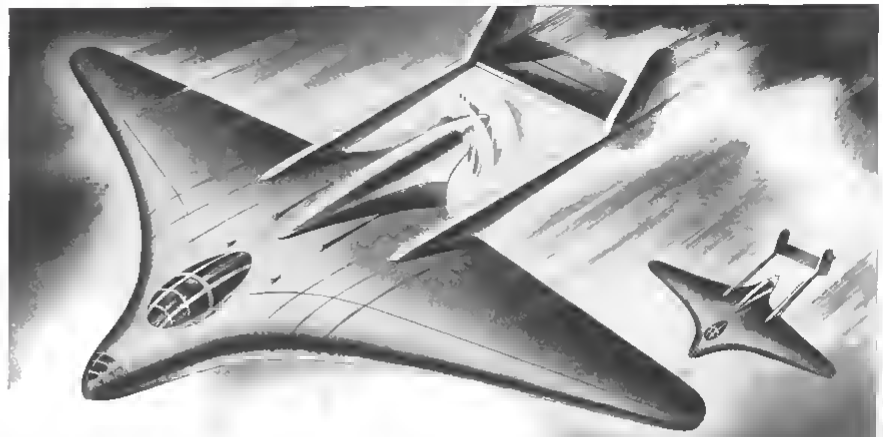
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these with many subheadings. Tables and illustrations, which are generously supplied, fall naturally into place throughout, where they are convenient for reference but not overwhelming to the student. Broadly, the subject is developed as follows: fundamentals of welding, processes, allied processes; metals, training, inspection, and safety; design considerations, applications.

MANUFACTURING PROCESSES *by Myron L. Begeman. Published by John Wiley & Sons, Inc. New York. $4.50*

This book provides the elemental information commonly supplied to engineering students, for whom it is intended, but is little more than an outline and not, for this reason, of much value to men versed in production. Most of the book deals with metals and metal working processes, though there are some particulars on woodworking equipment and plastic molding.

Although the index contains no reference to the important phase of metal working known as stamping, several pages are given to types of presses and the general type of work they do. In the book there is, in short, rather more of an academic slant than an appeal to practical production men, though this is perhaps inevitable in a book designed for student use.

AIRCRAFT WELDING *by L. S. Elves. Published by McGraw-Hill Book Company, Inc., New York. 132 pages, illustrated, indexed. $2.00*

Designed as the text for a course in aircraft gas welding, but complete enough to serve as a guide for individual study in the home or shop; plentifully illustrated, largely from photographs of demonstration welds and actual parts and assemblies of well-known makes and models of planes. The author has long been a practical aircraft welder and has also instructed for more than five years. Subject divisions are: equipment, tools, materials, welds—characteristics and types, stress, jigs, methods of construction, aluminum and stainless steel welding, exercises in aircraft welding, drawings and prints, tables and Air Corps specifications.

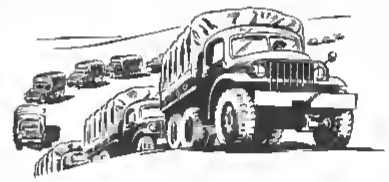
COMMERCIAL AIR TRANSPORTATION. *by John H. Frederick. Published by Richard D. Irwin, Inc., Chicago. 506 pages, illustrated, indexed, and paper maps. $4.00.*

A studious and detailed review of commercial air transportation in the United States, starting with the historical and regulatory background and culminating in the present state, the problems, and the future of airline traffic—passenger, mail, and cargo. Equipped with 45 tables, 44 figures, bibliography, 3 appendixes, and illustrated with photographs of typical airliners. A painstaking survey, well documented.

ENGINES, PARTS IV, V, VI *edited by E. Molloy and E. W. Knatt. Published by Chemical Publishing Company, Inc., Brooklyn, N. Y. 120, 128, and 144 pages, illustrated, indexed. $2.50 each Part.*

These three volumes in the Aeroplane Maintenance and Operation Series are concerned with the following engines respectively: Part IV, *Dagger I, III* and *Cheetah X*; Part V, P&W *Wasp Jr. B*, *Wasp H-1*, *Hornet E*, *Twin Wasp C*; Part VI, Wright *Cyclone 14*, *Cyclone* GR1820 G200.

They are handbooks made up in the style of running text, illustrated with drawings and photographic views, and they cover substantially in each case the proper treatment of the engine from the time it is new to the completion of testing after a major overhaul, including detailed description of the engine, technique of timing, disassembly, reassembly, and inspection, and operating specifications and limits.



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How Much Passenger Traffic

(Continued from page 218)

	U. S. Population (000,000)	R. R. Passengers (000)	% Pop	Pullman Passengers (000)	% Pop	Auto Registrations (000)	% Pop
1900	75	584 896	770 0	7 164	9 4	8	
1910	91	971 683	1068 0	20 203	22 6	458	11 5
1920	105	1 269 913	1209 0	39 255	37 2	8 226	7 8
1930	121	780 432	650 0	53 434	47 6	23 122	19 1
1933	125	434 848	347 0	13 716	11 0	24 601	19 5
1939	130	454 032	348 0	15 685	12 0	25 781	20 1
1940	131	456 088	347 0	14 755	11 2	27 456	20 9
1941	132			16 811	12 7	28 805	21 8

It will be noted that in the railroads' peak year (1920) total passengers carried were equivalent to twelve times the population of the country, Pullman passengers represented 37.2 percent of the population and passenger automobile registrations 7.8 percent. By 1940 railroad passengers were only 3.47 times population and Pullman passengers only 11.2 percent, but passenger automobile registrations had risen to 20.9 percent and to 21.8 percent by 1941. Airline revenue passengers in 1941 were 3,768,892, equivalent to 22.3 percent of Pullman passengers and 2.9 percent of population.

When reasoning from the collected data in an attempt to set a probable top figure for airline travel many intangibles have to be given consideration. For instance, despite the swiftness of air transport, its time saving character and unexcelled comfort, there may still be people who prefer and will find it necessary to stick to terra firma, hence it would be unreasonable to assume that over the next thirty years or so substantially all rail, bus and auto travel will have been eliminated and that everyone will be flying. It seems evident that, for an indefinite period, travel will be apportioned over rail, auto and air.

It does not seem unreasonable to assume, however, that in view of the unique advantages of air transport, the Pullman peak percentage of 37.2 percent in 1920 will be exceeded substantially, and that 72,000,000 passengers annually might be carried by the air lines by the year 1980. This would be equivalent to approximately 45 percent of the projected population for that year, nearly twice the Pullman 1920 peak total, and about four and a quarter times the 1941 Pullman figure. This assumption is further predicated on a good safety record and a scaling down of passenger fares.

In order to minimize some variety into these speculations two other estimates are offered, one somewhat more conservative and another somewhat more liberal. On the conservative side a peak of 51,000,000 passengers is assumed for the year 1975, equivalent to approximately 32.5 percent of projected population which is somewhat lower than the Pullman peak percentage of 37.2 percent. On the liberal side a peak of 90,000,000 by 1975 is assumed, equivalent to 57 percent of population.

These assumptions have been charted as three "expectancy curves" in Fig. 7.

To translate passengers into passenger-miles is another problem. In 1941 the average number of miles traveled per reported revenue passenger on the domestic airlines was 363, compared with 382 in 1940, 394 in 1939, 405 in 1938 and 426 in 1937. Pullman passengers on the other hand have been steadily increasing the average distance traveled. In 1941 the average mileage traveled per passenger was 596, compared with 556 in 1940, 542 in 1939 and 532 in 1938. It should be borne in mind, however, that the method of counting passengers differs. An airline may count an individual passenger several times on his trip, depending upon the number of routes over which he flies, whereas Pullman counts a passenger only once for the entire length of his journey, provided he purchases a through ticket.

This declining airline average doubtless reflects the effect of the opening up of a number of shorter flight routes in recent years and the tendency of the public to use air transport for relatively short distances, whereas formerly the prevalent practice was to fly only the longer distances. With the inevitable growth of a feeder network it is quite possible that the average may decline further, although, on the other hand, the ultimate effect might well be to increase the average air distance traveled from point of departure to point of destination, in that the feeder lines will eliminate a great deal of auto and train travel to trunk line airports.

In this study an average trip of 400 miles per passenger has been assumed. In Fig. 8, next to the scale for revenue passengers, there has therefore been added a scale which indicates the revenue passenger miles which the estimated revenue passengers might be expected to produce.

A scale showing passenger revenue at the rate of 5c and 2½ per mile respectively is also indicated, and in addition a scale showing sent-miles based on an average load factor of 70 percent.

Fig. 9 shows the reported number of revenue passengers carried by the air



DOUGLAS DC-5 Long Range Transport, in service with the Royal Dutch Airlines.

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TECHNICAL LITERATURE

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OPTICAL PROPERTIES MANUAL
PLEXIGLAS FABRICATING MANUAL
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SPECIFICATION OF TOLERANCES FOR PLEXIGLAS SHEETS & FABRICATED PARTS
MECHANICAL AND ELECTRICAL PROPERTIES OF PLEXIGLAS & CRYSTALITE
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PHYSICAL PROPERTIES OF PLEXIGLAS HARDNESS
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lines each year compared with "Expectancy Curve B" The close agreement between the two will be noted

In closing, it is perhaps pertinent to recall that the Civil War was followed by an era of railroad expansion, and that World War I was followed by an era of automobile expansion. Is it not likely that World War II will be followed by an even greater era of aviation expansion?

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Fairbairn Co.'s Reports
Airline Companies' Reports
Civil Aeronautics Authority Publications
The Economics of Business Enterprise, by Walter Rautenstrauch
Applied General Statistics by Croxton and Cowden

New Ryan PT-25

(*Continued from page 235*)

built up from a single wood spar with wood ribs and plywood nose torque box Root ends of spars are reinforced with hardwood blocks at the center section, and are attached at four points at the root of the spar and one at the leading edge All ribs, spar flanges and spar assemblies are made to size from contour templates by means of routers and shapers, thus assuring accuracy at a fast pace and eliminating hand finish work

Stabilizer and fin are plywood covered wood spars and ribs, rudder, elevator and ailerons are fabric covered wood spars and ribs The center section perforated landing flap is built up of wood spar and ribs, plywood covered The electrically-operated flap can be controlled from either cockpit, and has a 75 deg maximum lowered angle

Fixed landing gear, built by Pacific Aviation Products, is full cantilever construction, with the welded truss assembly bolted to the center section spar Hayes wheels and hydraulic brakes are standard equipment. The 8-in. tail wheel is mounted on an oleo shock absorber, and is steerable from either cockpit.

Dual instruments include airspeed indicator, bank and turn indicator, rate of climb indicator, altimeter, clock, compass, tachometer, oil temperature indicator and oil and fuel gages

Power plant is a Lycoming O-435-1 six cylinder horizontally opposed air-cooled engine developing 185 hp at 2,550 rpm. with a Wickwire Spencer two-blade variable pitch propeller Eclipse starter and generator are standard equipment

In addition to primary training equipment, the PT-25 has night flying equipment including landing and navigation lights and the latest type instrument panel illumination

Specifications and Performance Data

Maximum speed	240 mph
Cruising speed	194 mph
Rate of climb	1 330 fpm
Cruising range	378 mi
Service ceiling	20 300 ft
Absolute ceiling	21 900 ft
Take off run (*In clear 50' obstacle*)	873 ft
Gross weight	1 800 lb
Wing span	32 ft 10½ in
Length	24 ft. 8½ in
Height	6 ft 7¾ in
Wing area	181.2 sq ft
Stabilizer area	18.92 sq ft
Elevator area	13.75 sq ft.
Fin area	5.2 sq ft
Rudder area	7.83 sq ft
Aileron area	16.66 sq ft
Flap area	7.07 sq ft

Drop Hammer Technique

(*Continued from page 133*)

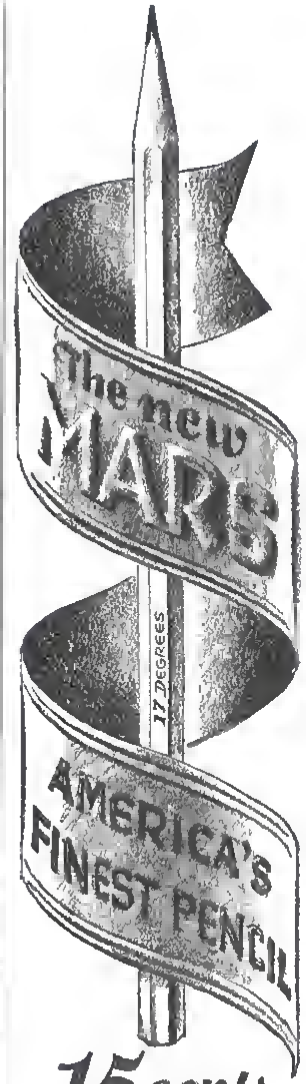
of rubber around the edge of the die can serve the same purpose Merely place the rubber around the ends of the sheet where the falling punch will come into contact with it (Fig 11) Thus will serve to restrain the sheet as the head of the punch is forced upon it. This practice is not generally recommended It is erratic when compared with other methods because of the lack of actual control over the operation.

Rubber Pads

Wrinkles can sometimes be prevented in deep draws by laying slabs of rubber directly on the part being formed These slabs are usually from ¾ to 1 in in thickness The depth of the draw resulting from each stroke of the hammer is restricted After each blow at least one layer of rubber, and more if possible, is removed As in the case of rubber and plywood pressure rings, the correct sequence of operations can be determined only by experimentation

The average part formed in a drop hammer is shrunk around the outside edge Occasionally, however, we have a part that must be shrunk in the center in order to form it, as in a part with a compound curve. This is accomplished by placing a pyramid of different size sheets of rubber about ½ in thick on the sheet of metal in the die, with the widest portion against the sheet This bottom sheet shall cover almost the entire area of the sheet of metal and the other pieces of rubber shall be in decreasing sizes (Fig 12). As the punch strikes the small piece of rubber on the top of the pyramid, the blow is more intense on the small area of the part in the center This difference in pressure is sufficient to prevent wrinkles from forming. As each piece of rubber is removed, the area affected by the blow is increased In this manner wrinkles are prevented from developing in the center of the sheet as the part is formed

It is the general custom to return a



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drop hammered part that has been heat-treated back to the hammer for final straightening. Simply place the piece back in the die and give it a few blows. Excessive metal is then trimmed off and the part sent to the proper departments for the finishing operations.

Occasionally drop hammered parts seem to develop 'oil-cans' during the heat treating process. When they come out of the hammer they are well formed parts. Yet, when they come from the heat treat tank they have developed irregularities. This trouble is not peculiar to drop hammer forming but shows up in other methods as well. The cause is in the heat treatment rather than in the production method. Heat-treatment normalizes work strains that have been set up in the part causing it to twist. By placing the part back in the die after quenching, it can be easily straightened.

America At War

(*Continued from page 99*)

but they might get tired of the bayonet and pistol sketch. As one voter told the Gallup boys, "An airplane can drop a bomb that will do as much damage as a thousand men, why not save the men and use the airplane?"

This kind of pressure could grow slowly enough so air power would expand without any headlines, or headlopping. Or it could bust out and force the Commander in Chief or the Congress to take action, accompanied by loud cheers.

To get more air power you have to take equivalent metal and man-hours away from something else, like rifles, or warships, or tank cars. That is a decision the responsible strategists have to make, and may God help them.

Maybe they are mistaken now, as they have been in the past. If you think so, you can always throw Gen. Mitchell at them, or a battleship or the Army's opinion that Russia would be beaten in three weeks. You can write letters to the President, or to the editor of the *New York Times*, to your heart's content. Nobody has been put in jail yet for his honest opinions.

But commanders of the U. S. Air Forces are not so much worried about what the Gallup voters think, these latter weeks, as they are about the thoughts of their own pilots and gunners and navigators and bombardiers and radio operators. Criticism of American airplanes has been put in such a way, and so much of it has been misinformed, that Air Force crews are wondering privately if the engineers and manufacturers and air arm officers are letting them down.

These air crewmen, especially trainees, do not necessarily know very much about the over all subject of airplanes. They just know their jobs on their particular types of planes. They only know that the enemy's planes have a hot sting. They read what the critics say, and their morale indicators go down. Criticism is good medicine for the big boys who can take it, but it should be administered cautiously in the presence of the young folks who do the fighting.

Putting all angles of opinion together, it cooks down to something like this: It is unreasonable to suppose that any small group of men can be in possession of facts and wisdom not possessed by the majority in the same line of business.

It is too true that hardshell men are in high places, and that they hang grimly to ideas they read in books at West Point and Annapolis 30 years ago. Everybody knows they did it when Gen. Mitchell told them what was coming, and they did it more recently in playing at squads right till Hitler taught them better.

But those things developed in peacetime. We are now in a desperate war, and the crustaceous are under great pressure from the audacious. Every move the conservatives make is watched and checked. The old school is giving ground to the new, every day. And the old boys do render a service: they keep the hotbloods from sticking their heads up and feeling a short, sharp shock, as the Mikado's executioner describes sudden decapitation.

Most of the critical talk is about American fighter planes. (Read "The Truth About Our Fighters" on page 93). Our Air Force fighters, it is said, are out climbed, out-ceilinged, and outmaneuvered by the *Zero*, Messerschmidt, the Focke-Wulf 190, and the *Spitfire*.

This could well be so. But no person soundly informed about warplanes will ever say that one airplane is better than another as a general thing. If you ask a man of real experience he will ask you first: Better for what? Where? In what circumstances? For he knows, as every man should know before he tries to talk for the information of the public, that every airplane is a bundle of compromises.

This is true the world around of ships, of machine tools, of almost anything you think of. In the case of the airplane, you can make it climb fast, or travel fast, or carry a big load or fly stable, or maneuver easily; you can use its lifting capacity for armor or guns or ammunition or radio equipment, or parachutes and safeguards for the pilot. You can't do them all, you have to compromise.

That is how our fighter planes were designed. The best answer to those who don't like them is that almost every time they meet the enemy, they beat him. The War Department has the records of engagements and losses, and you can read them for yourself. Our pilots have plenty of heavy guns to fight with, they have armor to stop bullets, so that they can come back and fight another day; they have fuel for long range so they can run the enemy down or accompany their bombers, they have efficient but heavy radios that help them to win and avoid death traps.

But this Communique does not aim to wield the whitewash brush. It is perfectly true that the enemy, and England and no doubt Russia, have fighter planes that will do things our fighters won't do. Some of them fly higher, maybe faster, and some can out-turn ours.

We can do that too, and we are doing it, only our compromise, we hope and expect, will turn out better than theirs. We are trying, with every brain cell our engineers posses, to climb faster, and fly higher, and turn shorter than anybody else, *and do it with plenty of armor and guns and ammunition and radios to boot.*

Beside the P-40s, the P-39s, P-51s, and P-43s, now in service on many fronts, we have two Air Force fighters and one Navy fighter in production and just getting into the field. At this writing we had no official reports on what they had been able to do. Perhaps the services will not say much about them for a while. They are the *Thunderbolt* P-47, the *Lightning* P-38, and the Navy's F4U *Corsair*, shipboard fighter. All three of these planes carry 2,000 hp. or better. With more horsepower than other fighters, they can do the same things and carry the guns and the range and the safety equipment. And, there are fighters readying for production which no one talks about.

That is about the only way a reasonable man can add up the fighter story. If you are still not satisfied, you must remember that we have been in actual war only ten months. The only way any armed force can learn about war at any given time is to be in it, clear up to the neck, and feel the heartache about failures, and things that don't work the way the tests indicated they would.

With watching the war three years, and being in it ten months, we've got the world's best medium bombers, everybody agrees; we've got the B-17 which can go out and fight and come home so many times that all observers are amazed, we are certainly not bested in dive bombers, in torpedo bombers, in trainers. And who would say that we are not plumb top in transport?—which is no less a weapon in this war than a fighter plane.

Except for the effect on the air arm personnel, it seems to be a good thing

(*Turn to page 289*)

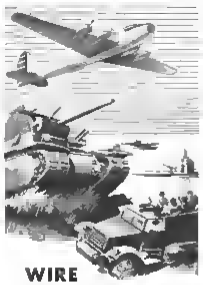


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(Continued from page 286)

that we have critics with enough guts to stand up and say then say No! one responsible person has even hinted that the critics should be piped down—even under any emergency law that might be invoked. The editors happen to know that the Air Force itself hasn't even suggested any such thing. What the Air Force actually did was start telling its story, in the press and on the air, Hallyburton style just as everybody else does in this country.

And to complete this report, notes briefly the other main developments in the world war the last few weeks.

British planes came to the East coast of the United States to join in the hunt for submarines that are dropping their supplies to the bottom of the ocean. This is a long step indeed since those shaky days when the British sent paddle jumpers out over their waters to scare submarine commanders—and did it, to some extent.

While Hitler and the Japs are striving night and main to join forces across Asia, British American and Soviet air powers *have already joined forces* in the air over Germany. Thus Germany is in an air scissor and will be in a ground scissor too, when the Allies attack on the West.

Brazil went to war—with an air force of several hundred planes which will be much help in connection with her Navy, in relieving the United States of heavy patrol duties. Many Brazilian pilot students are being trained at home and in the United States, and big Brazilian aircraft plants are going to work on American designs. Brazil is larger than the United States, her material riches are equal to ours, and she can in time build and operate strong air forces, for defense and for duty abroad.

In Columbia, just south of the Panama Canal, giant jungles contain rubber plants that could alleviate our shortage if we could get at them. There was a plan developing at this writing to build airports and haul the gum out in airplanes. The question was whether it could be done before we could make synthetic rubber in quantity.

Two or three months ago, a high Naval officer told AVIATION editors that the Japanese seemed to have had about ten standard aircraft carriers when the war started, and no one knew how many converted flat top steamers. He said he thought they had lost six of their regular carriers. If so, the Nippon fleet is seriously crippled. This information seemed to be borne out when huge bamboo rafts were cited in action, serving as floating wheeled plane bases.

Prettiest picture in the air is the performance of Boeing B-17 bombers. A Boeing official told the writers why—the Germans know it, for they now have possession of at least two B-17s. The *Fortress*, said the builder, gets up high, quite out of reach of much AA and aerial attack. It has lots of big guns, pointed all directions, to hold off attackers. It is swift, and it is maneuverable, it can be thrown around like an overgrown fighter. And—remember those Boeing 247 transports that flew ten years on the airlines are now in war service? This official told us he is building the B-17 with the same ruggedness. You can shoot it to pieces but the pieces stay together.

Harnessing the Stratosphere

(Continued from page 137)

Air conditioning engineers use what they call a "K" factor for figuring cooling surfaces. "K" is a factor representing the number of heat units that will pass every hour through a square foot of surface for each degree that the temperature on one side differs from that on the other. For cooling coils at ordinary cold temperatures, it is from 4 to 6. But for some unexplained reason, when very low temperatures are used, these normal factors do not hold and values as low as 1½ to 2 must be used. It is apparent that such coils become unduly large.

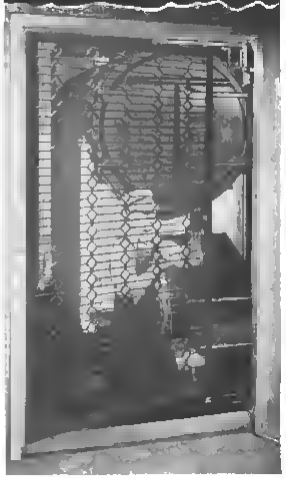
The choice of refrigerants used inside the chilling coils is another serious problem to be carefully considered. Most gaseous refrigerants that have suitable working pressures at low temperatures, develop high pressures when the equipment is shut down, and become explosive when mixed with small volumes of air. Ethane, for example, which at —90 deg. F., has a pressure of 35 lb. per sq. in., at 100 deg. develops a pressure of 800 lb., and is explosive at as low as 3 percent. Units using gases of the Ethane type become bombs and as far as destructive effect goes, might just as well have been dropped from an airplane.

The choice of proper gas to use for refrigerant is extremely limited. Carbon dioxide, which would be an ideal gas for this purpose as at —90 deg. has a pressure of approximately 35 lb. gage, is unpractical because the pressure rises to over 1,000 lb. per sq. in. at room temperature. It also involves specially constructed stuffing boxes and such heavy machinery that carbon dioxide compressors are prohibitive.

The best gas available today to the engineer is $CHClF_2$—Monochlorodifluoromethane. It has a boiling point of approximately 3½ lb. per sq. in. at —90 deg. F., and only 160 lb. at 80 deg. F. The defect this gas possesses at the present time is its cost and availability, so it must be used carefully. Even with

(Turn to page 291)

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Mart Brown, chief test pilot for Cessna Aircraft Co inspects the Air Maze air filter on a Jacobs Engine of Cessna's AT-17 Army bomber-pilot trainer

Cessna Photo

Helping the "Bobcat" keep its nine lives

Cessna's famous "Bobcat," shown above, has proved its ability to "take it" day in and day out as one of the Army's important bomber-pilot trainers

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this gas operating at —90 deg F, there is still the disadvantage of handling large volumes One pound at —90 deg occupies over 13 cu ft and for proper handling requires cooling coils of especially large diameter

An airplane flying in stratospheric temperatures may have to dive so that the temperature will soar from 70 deg below to 70 deg above zero in but a few moments. It is simple to picture what happens to planes subjected to this sudden change of temperature. To meet this change, the modern Stratosphere Chambers have installed in them large electric heaters These heaters are so wired that very rapid changes in temperature can be effected, yet by simple switching, the wattage can be greatly reduced. This reduction in energy output is quite necessary, if efficient control is to be accomplished The reduction from quick heat to controlled heat may be as much as 90 percent In other words, 5,000 watt heaters may be required to quickly bring the chamber to required temperature, yet 500 watts may be sufficient to maintain and control it accurately at that point.

Features making it possible to change temperatures at given rates and in given cycles are incorporated in Stratosphere Chambers so that instruments may be tested over fixed periods and at given rates of temperature change. Besides the necessity of maintaining and controlling constant pressures and constant temperatures, humidity must also be controlled This is especially true where electric equipment, such as condensers, etc, is under test The dielectrics of most products are materially affected by humidity changes If an instrument is to work equally well in the Panama Canal zone and in the Gobi Desert, it must be calibrated at different humidities to take care of this

Relative humidity—the ratio between the weight of water vapor present in the air and the maximum weight of water vapor that same air could hold at a given temperature—is one of the engineers most serious problems. When the air is hot, it will hold a great deal of moisture, when cold, very little this air at 140 deg will hold over 1,000 grains of moisture per pound of air, whereas the same air at zero will contain only five grains. Thus it is obviously extremely difficult to obtain and control humidity at low temperature Also, due to the fact that there is very little moisture present, even at 100 percent relative humidity, the effect of humidity at low temperatures on the ordinary run of instruments is negligible and in most cases, neglected This is not true at higher temperatures. Here the humidity plays an important part Note the feel of paper on a damp day, and

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In order to produce humidity, it is necessary to increase the vapor pressure of water to such a degree that it will equal the vapor pressure of the humidity required. This can be done by the addition of chemicals, but is more easily done by the addition of heat. When raised to proper temperature, flow water is controlled so that it can be cut off abruptly to avoid overhumidification. In addition, it is necessary to insulate the unit so well that the sides do not reach a temperature below the dewpoint. If this happens, sweating occurs and water, of course, will upset humidity equilibrium. When it is remembered that at 100 deg. F and 95 percent relative humidity, the point at which moisture will sweat out is 98 deg. This clearly indicates how closely control must be maintained in order to secure satisfactory operation. Will heating can sometimes overcome this difficulty, as the heat then entering the chamber radiates from the walls which, in themselves, must have a higher temperature than the surrounding air, thus at a higher temperature than the dewpoint.

To secure dehumidification, the moisture is sweated or frozen out of the air. The refrigerating equipment used to produce low temperature is also used to produce low humidity. However, the refrigerating effect is supplied in another coil, kept separate and apart from the air stream, so that it will reduce as little as possible the sensible heat in the cabinet.

Conditions required for test are continually becoming more and more severe as the planes reach higher and higher altitudes. These conditions are reflected in the modern units which, to meet certain specifications, require altitudes as high as 60,000 ft.; temperatures as low as 70 deg. below zero; heat as high as 160 deg. above zero, with humidities reaching to 95 percent.

With these conditions met, laboratories have at their disposal a means for developing all small aircraft instruments and parts, and production departments can test and deliver to aircraft companies accurately calibrated equipment that makes American bombers and fighters superior to any in the world.

Thunderstorms

(*Continued from page* 103)

east isohyetal pattern. This might lead one to think the thunderstorms move in a path approximately normal to the direction of the wind. Most cases examined showed a direction approximately parallel to the wind, but in some cases where the wind speed was less than 10

(*Turn to page* 295)

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mph. the thunderstorms had no particular direction and in a few instances seemed to develop and grow against the wind. In a few of the cases there seemed to be a slight deflection to the right but in others such as the July 20, 1937, there seemed to be some indication of a deflection to the left. No conclusion on this particular point has been reached.

Size of Storms

By measuring the width of the isohyetal patterns produced by thunderstorms over the Muskingum network of stations it has been possible to determine with a fair degree of accuracy the variation in sizes of thunderstorms. In order not to include sprinkles or light rainfall, not necessarily associated with the main center of the thunderstorm, it was decided to consider the thunderstorm confined to the area bounded by the 10 in isohyet on each half-hourly chart. Measurements were limited to cases where the station network was sufficient to give reasonable accuracy. The tabulation showed that on the average the width of this rainfall pattern was about six miles. The extreme cases varied from a few miles to twelve miles.

In the *Meteorological Magazine* for February 1925, D. Brunt described an interesting experiment with a heterogeneous liquid in which convection cells were produced due to cooling by evaporation from the surface of the liquid. The experiment was performed by pouring two or three millimeters of a volatile liquid mixed with bronze flakes (gold paint) into a shallow dish. Vigorous evaporation from the surface of this liquid caused a cooling of the surface layer, yielding an unstable state and setting the liquid in motion which broke up into a number of separate cells. When the dish was tilted the size of the cells varied directly with the height of the liquid. In each cell there was an upward motion at the center which remained clear, a diverging motion at the top, and descending motion in the outer region. This cell is known as the Benard Cell (1), and it has been determined that the diameter of the cells is about 3½ times the height of the liquid.

There is no doubt that the thermodynamics in a thunderstorm cannot be considered to be as simple as that in a Benard Cell. However, it is possible that the size of a thunderstorm is dependent on the height of the instability layer in the atmosphere in much the same manner that the size of the Benard Cell is dependent on the height of the liquid, regardless of the complexity of the thermodynamics. In extreme cases it can be assumed that the height to which instability extends is the height of the tro-

(1) Ann. Phys. Chem., Paris, 23, 1901

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popause During the summer months this averages about nine miles over much of the United States This height multiplied by 3½ would give a cell diameter of 31 5 miles However, the only visual evidence in the atmospheric cell is the cumulonimbus cloud produced by ascending motion If the ascending portion is one-half of the total cell, its diameter would be one-half of 31 5, or about 16 miles. From observational evidence and from a consideration of the flow pattern in a moving system, which will be discussed later, the width of the portion of the cloud from which an appreciable amount (.10 in per half hour) of rain falls is approximately three-fourths or less of the width of the cloud This gives a width of twelve miles or less which is in good agreement with maximum values obtained by measuring the width of isohyetal patterns produced by thunderstorms for over a hundred cases in the Muskingum Basin,

Another check on this value can be obtained by using the mass curve of rainfall for a single thunderstorm when it can be determined that the center of the storm passed over the station Assuming the velocity of the storm to be approximately the same as the velocity of the air at 6,000 ft, and multiplying this velocity by the duration of the heavy rain we can obtain the width of the storm By using some of the mass curves of rainfall for the heaviest storms of record it is logical to assume that the storm center passed at or near the station In a study made for the Sevier Basin, Utah, the width of the area of heavy rainfall for the heaviest thunderstorms of record at Salt Lake City and Modena were evaluated in this manner and in no case did they exceed ten miles. This method is not applicable to thunderstorms produced by marked orographic lifting

If, as has been suggested there is a relationship between the height of the instability layer and the size of a thunderstorm, then this same reasoning would put a limit on the distance between thunderstorms This type of information would be of definite value to pilots and airline dispatchers If the diameter of the cell is about 3½ times the height of the instability layer and by observation of the cumulonimbus tops it is determined that this height in a particular area of thunderstorms is 16,000 ft then the distance between adjacent cumulonimbus clouds would be at least twice the radius of the individual cells or roughly in this case about 10 miles.

Conclusions

From a consideration of many of the factors analyzed and described it is possible now to arrive at some conclusions and offer some suggestions relative to the duration, size, and circulation of thunderstorms

In an situation studied did the duration of excessive rainfall or rainfall that can be called "flood producing" for a single thunderstorm continue for a period exceeding two hours The average duration was one half to one hour From observations of winds during several widespread and intense nonfrontal thunderstorm situations it was noted that the wind velocity at the 6,000 ft level averaged 12 to 16 mph and in practically all cases it varied from about 8 to 30 mph During periods with high wind velocities aloft it was noted that the duration of any single thunderstorm was appreciably shorter and the intensities lower This is probably due to the shearing effect of higher wind velocities aloft or the fact that a greater inflow velocity into the storm causes a more rapid release of the latent energy thereby causing it to attain its maximum intensity in a shorter time and, as previously indicated, shortens the duration The lower intensities can be accounted for by the fact that the relatively small portion of the storm where the most intense rain occurs does not remain over one place long enough to produce high intensities for long periods

By assuming some reasonable values for the diameter, velocity, and duration of excessive rainfall in an extreme thunderstorm we can obtain some idea of the area which would be enclosed by the heavy or flood producing part of the storm A reasonable value for the diameter of this part of the storm would be six miles, i.e., one half the diameter, determined for the thunderstorm which reached the tropopause If the duration is two hours and the speed of translation 15 mph, the approximate area is

$$A = r^2 + 2rvt$$

where r = radius, v = velocity and t = time in hours The maximum area covered by the flood producing part of a thunderstorm using the above assumed extreme values would be approximately 210 sq mi

For forecasting purposes the motion of non frontal thunderstorms can be determined from the winds at the 4,000 to 6,000 ft. levels However, as previously indicated, areas of non frontal thunderstorms develop and are dissipated with moving areas of convergence In the paper previously mentioned, by H T Harrison, in which he made a study of 31 thunderstorm weather maps he showed that in 23 of these cases the cause of the thunderstorms was best explained by a zone of convergence.

Several men have suggested the use of

(*Turn to page 299*)

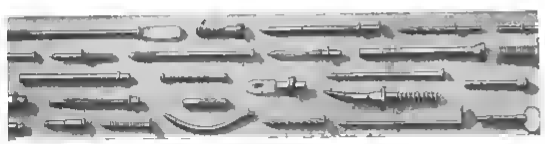


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SAN DIEGO ★ CALIFORNIA

At the First Flash of Fire

TONS* OF CO_2



AT THE TOUCH OF THIS BUTTON!



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CARDOX

NON-DAMAGING

FIRE EXTINGUISNING SYSTEMS

*A ton . . . less than a ton . . . or many tons! Cardox supplies all the CO_2 required for extinguishment.

A ton is a lot of CO_2! But in this huge new plant aviation engines—being proved in long rows of dynamometer test cells—MUST HAVE immediate, complete extinguishment for any possible fire! Behind this performance in this Cardox installation for damage-free fire extinguishment is the *immense* reserve of this highly effective extinguishing medium—*tons of it!*

The idea of CO_2 *by the ton* was unfamiliar at first. But at key points of American Industry on every side Cardox Systems are being recognized as a vital guarantee of uninterrupted war production.

As replenished by regular Cardox delivery service, the supply available at any moment—at any test cell or group of cells—is ample by a wide margin! First, to put out the fires quickly before the engines are ruined! Second, thereafter to prevent any re-ignition by heated metal in the fire zone! Third, to function again immediately for the protection of any hazard—including also the plant's facilities for handling, transfer and storage of gasoline and oil, propeller test cells and within test cell control rooms.

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BELL BUILDING • CHICAGO
Ask for Bulletin 3102

various methods for determining these zones of convergence in order to aid forecasters in forecasting the occurrence of thunderstorms. Any type map which could aid in this would certainly be a great help, as all forecasters know. A method developed in the Hydrometeorological Section by Mr. S. B. Solot is worth mentioning since at least in extreme cases the results seem to be definite. By using the azimuth angle and the distance from the observer of a pilot balloon after it has reached a certain height it is possible to determine the ocean west-east and south-north components of velocity of the layer of air from the surface to the given height. From these values it is possible to determine the areas of convergence. Some refinements of the method would undoubtedly be necessary but it is felt that a chart similar to this would be of definite help to forecasters.

Vidal Process

(*Continued from page 127*)

The process has branched out into the military field now, with the successful construction of fuselages for the *Anson* bomber now being used for training in Canada (Fig. 1).

The Universal Molded Products Corporation in Virginia, a licensee of the Vidal process, is negotiating a large Canadian Government contract for parts for the *Anson* bomber. The Allied Aviation Corporation in Maryland, another licensee, is also handling large contracts for airplane parts, working day and night and enlarging its facilities. One project in the works by a licensee is the molding of a transport glider capable of carrying a number of men and complete equipment. To form the fuselage of this craft a tank 9 ft. high and about 60 ft. long was required. This tank was formerly used by the New York Port Authority for fumigating imported bales of cotton and is now in successful operation on the Vidal process. To give some idea of the simplicity of other equipment used by this concern and other licensees, the Allied Company has a battery of pressure tanks formerly used in a tire factory in which smaller articles are made, such as bomber flaps and ski equipment.

Molded wood construction has proved so successful that literally great numbers of vital military projects are under way but are still shrouded in necessary secrecy. The principal advantages of molded plywood construction lie in the speed and economy of fabrication and markedly improved aerodynamic efficiencies. It is vitally important in view of the strategic metals situation. Finally, it will unquestionably be of key significance in peacetime aviation.

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. . . with Small Gasoline Motors

"Adequate" lighting at the front line, or wherever electric service is not available, can often mean the difference between life and death. How vital then, are the portable "lighting" units, powered by Briggs & Stratton 4-cycle, air-cooled gasoline motors, used by our armed forces. Their trouble-free performance affords dependable power wherever and whenever needed.



Our entire resources are now devoted to supplying Briggs & Stratton gasoline motors, to those whose equipment serves the war program, or is for "essential" civilian uses.

If you're now planning post-war production of gasoline powered appliances and equipment, or if your products fit these classifications, write us and we'll serve you as best we can.

Meanwhile Briggs & Stratton motors (3½ to 6 H.P.) now in civilian use, continue to set new records for trouble-free performance and long life. With reasonable care, their service can be still further prolonged.

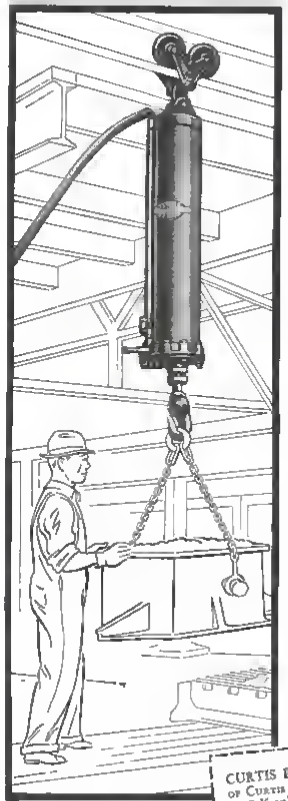
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Milwaukee, Wisconsin, U. S. A.

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Curtis One-Man Air Power Hoists provide faster, easier, more accurate lifting, they release skilled labor for other jobs, reduce man-power fatigue; and save time and money

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Ignition Trouble

(*Continued from page 211*)

when actnally the break may hava occurred elsewhere, It has been found that an ignition cable wheh has had its insulation ruptnreil may permit an engine to operate satisfactorily on idling, but when takeoff power is demanded with its attendant eylinder pressure, it has been found that the spark plugs would miss fire Actnally what occurred was that on idling with low eylinder pressures, relatively low voltage was required to jump the gap The relatively high voltage between ignition eables and ground, for full power requirements was sufficient to saturate some of the components of the eable dielectric anil cause it to break down Thus some or all of the high tension energy from the magneto was by-passed arnnnl the spark plug and therefore was nnt available to eause a spark at the gap

Tha remedy for this situation wouhl have been to install a new ignitnn eable and *not* to replace spark plugs Replacing the spark plugs ought have temporarily alleviated the tronble had their gups been increasnl dne to wear Proper gap settings wouhl have permitted a spark to occur at a lowei voltage than would have occnrred with a wider gap Obviously this condition is merely a stop gap, for it in no way removes the eanse of the trouble—the ruptured insulation

Faulty installation of the eable may hava prodneed abrasions, or it may havi resulted in stretching of the insulation in the manifold ring or elbows Defectivi eables are mnre snseeptible to electrical breakdown than perfect ones

Influence of Pressure Changes

Let us look into anothei typical sonrce of ignition tronnh At the atmospheric pressure of sea level, the air arnnnl the spark plug terminal becomes electrostatically charged as voltage is applied. This air may become saturated anil cause flash-over as a result of (1) increasing voltage at constant air pressure, (2) decreasing air pressure at constant voltage, or (3) a combination of both variables A spark plug operating in a medium of sea-level atmospheric pressure may function in a perfectly normal manner, but it may flash over when operated at the same voltage at the lower pressures encountered at altitude because the air has become electrostatically saturated Rough engine operation will result

When too much insulation has been removed from the ignition eable, leaving exposed or bare wire where it terminates inside the terminal sleeve, the flash over distance is reduced This condition, too, might appear to be corrected by replac

(*Turn to page 303*)



7 inches of concentrated DESTRUCTION

The Axis is getting the oxe of America's war production.

Production thot begins in thousands of factories with o 7-inch drowing pencil — A. W. Fober's WINNER Techno-TONE, America's standard of excellence.

Seven inches of polished cedor wood encasing precision milled and refined graphite—but whot a punch it pocks when transloting the genius of engineers, designers ond droftsmen into ships and tonks and plones.

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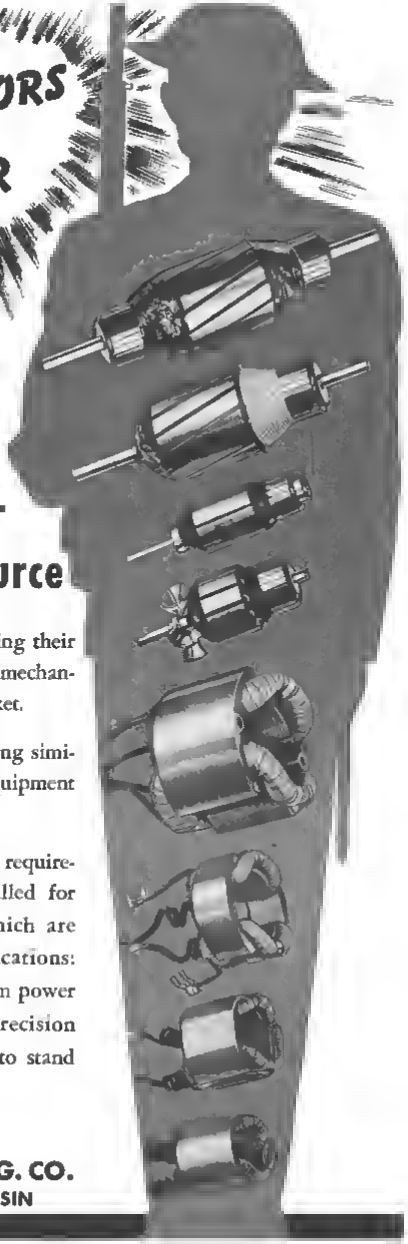
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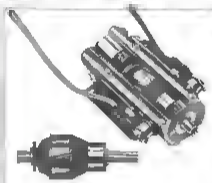


..the fractional h.p. field gained a new, but well-seasoned, dependable source

NEW— because Oster electric motors, now doing their part as power units in vital war instruments and mechanisms, had not previously been offered in the market.

SEASONED — because Oster has been building similar motors for 15 years, exclusively as original equipment for its own appliances.

DEPENDABLE — because Oster's peacetime requirements have always called for the very qualities which are essential in war applications: Light weight, maximum power in minimum space, precision manufacture, ability to stand up under abuse.



.0024 to .25 H.P.

Complete in housings 1½" dia. by 2⅝" long to 3½" dia. by 5½" long. Windings: shunt, series, or split-field 3-lead reversible series. Also permanent magnet motors 1" dia. by 2⅝" up.

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RACINE, WISCONSIN

ing spark plugs. In Fig. 1 it can be seen that the distance between the top of the sleeve and the exposed wire has been reduced so that flash-over of the air can be more readily brought about.

It is quite apparent that moisture or dirt on the terminal sleeve would assist flash-over. The resistivity of such impurities is much less than that of a thoroughly cleaned terminal sleeve. A great percentage of electrical breakdowns occurs in regions of moisture and dirt. It is therefore of the utmost importance that all leads and terminal sleeves be both clean and dry.

Method For Correcting Faults

We have discussed only a few types of faults that have occurred in ignition systems. Let us now examine methods of locating faults so that they may be corrected. To recognize that a fault exists is much easier than locating it. The problem of quickly and easily tracking them down is no longer the difficult problem it was before the advent of the ignition harness test set. Whether the trouble be caused by bare wire in the terminal sleeve, abraided or stretched insulation, a moist or dirty terminal sleeve or spark plug barrel, the test set will detect it quickly.

The ignition harness test set is an instrument designed to give visual indication of ignition system faults. Fig. 2 shows the schematic wiring diagram of such a set.

Let us make use of a bench test to locate a typical ignition system fault. If we fasten the "engine ground terminal clip" of the tester to a spark plug elbow which is assembled with a length of ignition wire and a new terminal sleeve and the "test clip" to the end of the terminal sleeve, the input lamp will light after the circuit has been energized. If the terminal sleeve is clean and dry, the output lamp will not light. If we moisten the terminal sleeve slightly, a spark along the terminal sleeve will give evidence that the dielectric has broken down. The output lamp will flash and visual indication of a fault will be apparent. If we allow a little water to run into the elbow from the back end so that the inside of the sleeve is moistened and, further, if we wipe all excess moisture from the wire surface until the outside of the sleeve before testing, we will find that the output lamp will light, and again indicate a fault, when the circuit is completed. In this case the visual indication means that the sleeve is damp and hence no longer an insulator.

If we puncture the ignition cable insulation with a pin or needle and place an elbow over it, the output lamp will flash when the switch is closed. In as quick and easy a manner, cracked, abraided, or stretched insulation faults can be detected.



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"Revolutionary" is what production engineers say about this high speed method of forming bulkhead rings and other heavy gauge extrusions. For the first time in aviation history, extrusions are now being formed on a machine-production basis—with amazing increases in output per man-hour.



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With correct application on each of the four heads, the following work can be produced: Practically any type extrusion with reverse curves, slow sweeps, off-sets, compound curves and joggles. Some flat sections and all kinds of power brake or rolled sections.

Forms Many Parts TWO OR MORE AT A TIME

Prominent aircraft builders now using these machines often form two mating parts at a time—frequently machine-producing up to 90 parts per hour that formerly required 35 minutes each to hand form. That is almost like forming extrusions *by magic!* ★ ★ ★ Because special equipment must be designed for special work, we suggest you *submit your problems* for engineering determination. Write for complete data on your company letterhead.

P.S.—WATCH FOR IMPORTANT ANNOUNCEMENT IN NOVEMBER ON SPECIAL, NEW TYPE METAL FORMING MACHINE VITALLY IMPORTANT TO YOU!

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Field Tests Similar

The locations of ignition system faults on engines are as quickly and simply located as those of the bench tests described above. Field experience with the ignition harness test set has shown that it has reduced the time of locating ignition system faults to an absolute minimum over the previous haphazard trial-and-error method.

The spark plug also may be a source of potential trouble and until recently few methods existed whereby they could be electrically tested so as to approach operating conditions. The purpose of this test is to disclose weaknesses of the component parts of an assembly when test conditions simulate operating conditions.

There have been many approaches to the problem of providing a simple and unerring method of testing spark plugs as has been accomplished by the ignition harness test set for ignition troubles. The spark plug should be viewed as nothing more than a high grade insulator designed to break down its electrical resistance under predetermined conditions. This point of view is helpful in appreciating both its manufacture and function, as well as the care which should be exercised in its use.

Of the many methods developed, the alternating current bridge bomb method seems to the writer to be the most satisfactory, despite characteristic shortcomings of AC bridges. In this type of test unit the assembled spark plug is placed in a bomb, and put under pressure. The schematic circuit diagram of the spark plug test set is shown in Fig. 3. It will be noticed that the spark plug constitutes one arm of the bridge circuit. The purpose of this test is to determine the insulating qualities of the spark plug. The voltage applied to the circuit is adjusted until the voltmeter reads 90 v. The bomb pressure is adjusted to 450 lb. per sq. in. Pressure is applied to the nose of the spark plug by CO_2, as it is more universally available than other gases. When the circuit is energized, the output lamp will not flash—if the spark plug is in good condition. Should the plug be faulty, the output lamp will flash, thus giving an indication that that particular spark plug is not acceptable.

Flash-Over Voltage

An interesting example of an apparent anomaly warrants consideration here. The voltage required to cause flash over along the barrel of a spark plug, the terminal sleeve or through the insulation of the ignition cable if they are moist or dirty, may exceed the voltage required to produce a spark between the electrodes at properly set gaps. As the gaps widen due to usage, the voltage required to cause a spark will increase and will be in excess of these values. As the gap setting increases, the voltage produced by the magneto causing the spark will increase. This high voltage may rupture the moist terminal well, the defective terminal sleeve or the cable insulation, and cause rough engine operation. Had these plugs been removed from the engine, and bridge bomb tested they would have been found electrically sound. Even if they had been properly regapped or replaced by new spark plugs, the trouble would have remained. Such hidden flaws in the ignition system can be detected by methodically using an ignition harness test set.

While these faults are but a few of the many which can and do occur in ignition systems they are nevertheless the most commonly encountered and if they are corrected the major causes of trouble will be overcome. The method of proceeding to locate other faults is similar to that described. With the advent of new concepts of ignition harnesses consistent application of operators and servicemen to the basic principles of each new idea and test method is imperative if successful operation is to be insured.



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If you have worn Bausch & Lomb Ray Ban Sun Glasses for sports flying, driving—any summer use—you know how comfortable they are on your eyes, how they sharpen vision. If you have planned to buy Ray-Bans this year, you may find your dealer out of stock. This is because practically the entire Bausch & Lomb production of Ray-Bans—like that of binoculars and many special optical instruments—is required by the armed forces. Today's emergency justifies any sacrifice you or we may be called on to make.

Your Eyesight Specialist supplies Ray-Ban lenses on prescription.

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Several years ago, at the request of U. S. Army officials, Bausch & Lomb developed a special anti-glare glass for use in height over-cloud flying. This glass, known as Ray-Ban, has the remarkable property of filtering out excess glare-producing light, at the same time transmitting most of the light useful for seeing. Army, Navy and airline pilots—as well as target shooters and motorists—have welcomed the cool, comfortable, keen vision that Ray-Ban affords.

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HOW TO SIMPLIFY *PRP* RECORD KEEPING

● You can wrap your whole PRP problem in a single two-word package—*balanced inventories*. For, with all of its manifold reports and restrictions, PRP aims at nothing more than accurate gauging of your raw material needs.

But *administering* your PRP problem is a different story. It takes facts. Usable facts that are easy to summarize. Working records that are easy to analyze. And it is this need that Kardex fills by *simplifying* PRP recording.

Like this: with a Kardex system like the one shown below, many aircraft manufacturers are able to *group all items of each class of material* by PRP classification. Thus, it is a simple matter to *prepare* usage statistics, to *forecast* material requirements, and to prevent unnatural inventories that disturb the flow of current supplies.

What's more, the exclusive Kardex Graph-A-Matic signalling principle reveals, at a glance, the exact position of your inventories in terms of weekly or monthly supply. It helps you correlate purchases with allocations, prevents overstock and understock, and is particularly helpful in preparing detailed PD-25P Interim Applications.

It is this basic "balanced inventory" system shown below, that does the ground-work for the incredible new Kardex PRP Summary Record—the plan that reduces difficult PRP recording to a simple accounting procedure.

Free PRP Record Study

Remington Rand record engineers have just completed a detailed analysis of the PRP recording problem — with a documented solution. This study is based on facts gathered from actual users of the system described. You may have a free copy, without obligation, by writing Remington Rand, Buffalo, N. Y. — or phoning your local Remington Rand office.

KARDEX EQUIPMENT IS NOW AVAILABLE WITHOUT CRITICAL MATERIALS!

HERE'S A THUMB-NAIL SKETCH OF THE KARDEX INVENTORY PLAN

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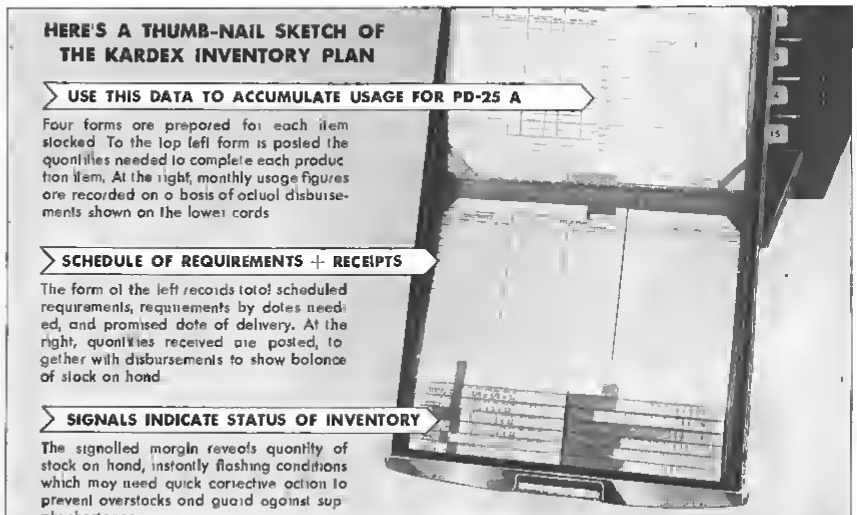
Four forms are prepared for each item stocked. To the top (left) form is posted the quantities needed to complete each production item. At the right, monthly usage figures are recorded on a basis of actual disbursements shown on the lower cards.

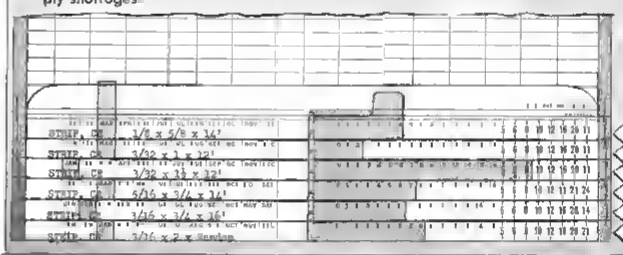
SCHEDULE OF REQUIREMENTS + RECEIPTS

The form at the left records total scheduled requirements, requirements by dates needed, and promised date of delivery. At the right, quantities received are posted, together with disbursements to show balance of stock on hand.

SIGNALS INDICATE STATUS OF INVENTORY

The signalled margin reveals quantity of stock on hand, instantly flashing conditions which may need quick corrective action to prevent overstocks and guard against supply shortages.





HERE'S WHAT THE VISIBLE MARGIN SAYS

BALANCED 6 WEEKS STOCK
SHORT 2 WEEKS STOCK
OVERSTOCK 11 MONTHS STOCK
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BALANCED 6 WEEKS STOCK
BALANCED 8 WEEKS STOCK

Another Kardex Wartime "Expediter"

by REMINGTON RAND INC.

Blimps Return

(*Continued from page 207*)

In the present conflict the slower speed of the blimp gives it advantage over the swifter airplane in submarine and mine defense, and in the convoying of ships. Its speed can be throttled down to that of a convoy; its crew can see deep below the surface of the water—as far as 90 ft.—and are better able to pick out the telltale oil smear or line of bubbles which indicate the presence of an undersea boat.

American blimps during the last war were based at shore stations at 150 mi. intervals along the Atlantic Coast. They covered some 400,000 mi. of patrol and on several occasions discovered suspicious barges and other craft along the steamship lanes into New York which were carrying mine paraphernalia. They also spent much of their time scouting for enemy submarines which were far fewer in number than in the present conflict.

Today's lighter-than-air patrols along the Atlantic Coast have ultra modern bases with both hangars and mooring masts, mobile and fixed. Their patrol area is generally the stretch of water lying within the so-called "100 fathom curve" that area where coastal shipping is concentrated and where submarines might be expected to lurk.

The latest type airship destined for patrol use is constructed for duty in close cooperation with the fleet. The crew of eight—two pilots, radio men, riggers and mechanics—all acts as observers. Upon sighting a U-boat the blimp can attack with depth bombs or machine gun fire. If the sub gets away, destroyers can be summoned promptly to the location to aid in locating and destroying the undersea boat.

In another phase of the lighter-than air field, official Washington now apparently takes the same view regarding the wartime usefulness of the rigid airship of the *Macon* and *Akron* type as do proponents who have been clamoring for the construction of such vehicles for some time.

The long cruising range of the *Macon*-type airship, despite the tragic history of such large, rigid craft, would be extremely useful for reconnaissance in the great distances of the South Atlantic and the Pacific, its adherents maintain. They further claim that the large dirigible can also be used as a flying aircraft carrier to transport as many as six small bombing planes to points near the scene of an attack. Other duties might be to carry large numbers of parachute troops, munitions and armament. The great range and speed of the rigid ship would enable it to operate in areas impossible to planes, and at speeds impossible to surface ships.

Indications are that some further action will be taken in the near future to build one or more of these dirigibles for adequate protection of our shipping in the vast ocean reaches.

Meanwhile the blimps we have continue the grind of daily patrol, working with airplanes of the Army, Navy and CAP and the growing number of surface ships which are inevitably turning the tide against what has been one of the most effective offensive weapons in the sea, the U-boat.

COMPREGWOOD

Impregnated Super-Pressed Phenolic Plywood
Made to order in shaped or flat elements of any desired thickness with dimensional stability carried to new heights.
INQUIRIES SOLICITED

Designers and Engineers are Invited to explore the exciting qualities of the new material, Compregwood
Complete Laboratory Research Facilities Available



Adjustable pitch fast globe with molded Compregwood blades, as supplied to U. S. Navy and Army Air Corps, are but one of the many applications of the new material, Compregwood.

CAMFIELD MANUFACTURING CO.
GRAND HAVEN, MICHIGAN

Employing the latest advancements in the phenolic impregnation of woods, with radio frequency curing. Fully equipped for volume production.

Folke–Wulf

(*Continued from page 233*)

have elevator and rudder trim tabs, the Focke-Wulf stabilizer is adjustable, making it more vulnerable to concentrated fire power.

The fuselage is also built in one piece and is very well streamlined, narrowing vertically practically all the way back from the engine. The entire cockpit cover, including rather long fairing, slides back but it cannot be opened in flight. Emergency exit in flight can only be accomplished by pushing a button which detonates a cartridge which breaks the supporting member, allowing the

(*Turn to page 308*)

EVERY GRINDING APPLICATION . . .

PLUS DOZENS OF OTHER JOBS

WITH Thor PNEUMATIC ROTARY GRINDERS



Light, Easy to Handle "Bantams"

Adaptable to all types of production grinding and die work for shop, laboratory or work bench, Thor small wheel grinders can add the *PLUS* to aircraft speed production because they can be used with many accessories on countless *other* applications!

Widely popular as grinders with airplane manufacturers as well as machinists, plastic manufacturers, tool and die makers, and other mechanics, Thor "Bantams" can also be used extensively with mounted points, rotary files, steel cutters, soft felt and rubber polishers, wire wheels, and other accessories.

Easy to handle on *all* these applications because of their bantam weight and small size, Thor rotary grinders are available in six small models ranging from 1⅛ *pounds* to 4¾ pounds! Write today for full particulars in the Thor 52 A Pneumatic catalog to Independent Pneumatic Tool Company, 600 West Jackson Blvd., Chicago, Ill.

Bantam of them all is the Thor 000 Pneumatic Rotary Grinder . . . weighs 1⅛ *pounds* . . . measures 5½ *inches* . . . and does *dozens* of jobs with the speed and stamina of a heavyweight!

Thor *Portable Pneumatic and Electric Tools*

INDEPENDENT PNEUMATIC TOOL COMPANY

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entire cover to be blown away

All the fuel is carried in the fuselage in two self sealing tanks, one of 64 gal immediately behind the pilot's seat, another of 51 gal under the seat

The electrically operated inill retracting landing gear has a trend of 12 ft, apparently made necessary by the high landing speed—approximately 110 mph It is also set well forward to permit heavy braking without nosing over An interesting feature of the landing gear is the tail wheel retraction, a cable attached to one of the front wheels automatically pulling the tail wheel up into its well.

Pawar Plant

Power is supplied by a BMW 801D 14 cylinder radial, air-cooled engine developing slightly under 1,600 hp at 2,700 rpm for takeoff and just over 1,750 hp at 3,000 rpm at 18,000 ft. Cowling is extremely close set, the diameter being but 52 in, necessitating installation of a large fan set just behind the propeller The oil radiator is set just inside the nose of the cowling, cooling being effected by a reverse flow through the radiator and out through a narrow opening at its front Extensive baffling distributes the air to all the cylinders with the heated air being exhausted through long louvres cut in the cowling sides Unlike the BMW 801A, there are no facilities for sliding the nose ring or cowling at the back of the motor to adjust the flow of air

The electrically operated, three-blade, constant speed VDM propeller is of rather small diameter—due to landing gear restrictions—but the blades are of long chord almost all the way to the tips

Armament and Armor

Armament consists of two 7 92 mm machine guns mounted atop the fuselage firing through the propeller, two 20 mm Mauser cannon mounted in the wings, also firing through the propeller, and two 20 mm Oerlikon cannon also in the wing but firing outside the propeller are Despite the fact that four of the six guns fire through the propeller, the fire power totals about 3,500 rounds per minute—1,200 for the machine guns, 1,400 rounds for the inboard cannon and, strangely enough, but 900 for the outer cannon Effectiveness of the fire power is curtailed due to the short range of the machine guns and low muzzle velocity of the Oerlikons

Provision is also made for attachment of a 550-lb bomb beneath the fuselage for very short range operations.

The plane is well armored A 5 mm plate protects the oil radiator in the nose ring cowling and the aft portion of the cowling is fitted with 3 mm plate Cockpit windshield has 2½-in-thick bullet-proof glass and a bulkhead behind the pilot's seat is 8 mm. thick A 14-mm thick panel is fitted behind the pilot's head in the movable cockpit cover

Performance Not Outstanding

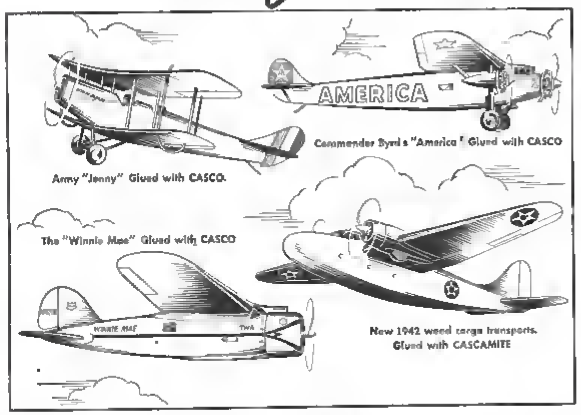
Performance range of the 190 is limited, its most effective altitudes being above 15,000 ft and below 25,000 ft Its top speed at 4,500 ft., for example, is but 326 mph compared with 375 at 18,000 ft It can, however, do 390 mph at 20,000 ft for one minute by means of a booster Reports from American bomber crews indicate the Focke Wulf does not perform well near its reported service ceiling of 37,000 ft British fighters are understood to be able to turn inside the 190, even at its most efficient altitudes

Specifications and performance data are as follows

Wing span	34 ft. 5 in
Length	29 ft. 4 in
Wing area	201 sq ft
Wing loading	42 2 lb /sq ft
Power loading	5 3 lb /hp
Gross weight	8,520 lb
Weight empty	6 240 lb
Maximum speed (18,000 ft.)	375 mph
Landing speed	110 mph.

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CASEIN COMPANY OF AMERICA

Aircraft Glues

DIVISION OF THE BORDEN COMPANY

Altschul

(*Continued from page* 200)

short term financial policies

United Air Lines disbursed 20c a share in 1936 While no official comment has been forthcoming, a token payments this year would surprise no one

The historical dividend record of Western Air Lines looks relatively good It must be noted, however, that the present company does not represent the extensive system of former years The old company paid a total of $1.35 a share in dividends during 1929 to 1931 inclusive A partial liquidating dividend of $2 50 in cash and 1 and ½ shares of TWA stock were also disbursed for each share of Western Air in 1934 A cash dividend of 25c per share was paid by the reorganized Western Air in 1936

Its stock closely held up until recently, Delta Air Corp has treated its former stockholders well. This combined airline and dusting organization paid $2 per share in 1938 and $1 in 1939 and again in 1940.

According to published available records, the following airlines have thus far failed to declare any dividend payments: Braniff, Continental, National, Northeast, Mid Continent and Pennsylvania Central With the possible exception of National, none of the above named lines may be expected to change their records this year

Pioneering and growth constantly require capital The airlines are presently in a position to make some small dividend payments but no substantial sustained dividend disbursements need be anticipated from this group for some time to come

Profit Limitations

(*Continued from page* 100)

specifically mentioned under admissable costs, it is not to be automatically excluded and conversely, if an item of cost is not listed under inadmissible costs . it does not therefore follow that such item is acknowledged to be admissible." In other words, wide latitude is present in determining special cases on their individual merits

Among the items which are not admissible for purposes of computing cost of performing a government contract, the following are enumerated

(*a*) Allowance for interest on invested or borrowed capital, however represented

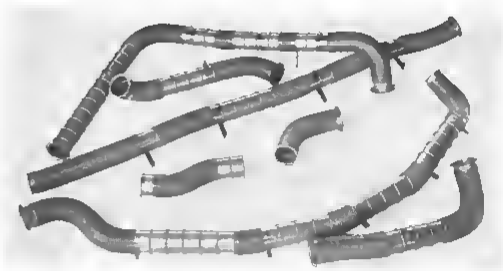
(*b*) Commissions, bonuses, and special premiums under whatever name, paid in connection with negotiations for or procurement of a government contract (See explanation)

(*c*) Entertainment expenses

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(*d*) Dues and memberships other than in regular trade associations

(*e*) Donations other than those contributions to local charitable or community organizations to the extent constituting ordinary and necessary business expense

(*f*) Losses on other contracts

(*g*) Losses from sales or exchanges of capital assets

(*h*) Extraordinary expenses arising from strikes or lock-outs

(*i*) Fines and penalties

(*j*) Amortization of unrealized appreciation of values of assets

(*k*) Expenses, maintenance and depreciation of excess facilities other than reasonable stand-by facilities

(*l*) Provisions in reserve accounts for contingencies, repairs compensation insurance (except as provided with respect to self-insurance)

(*m*) Income and excess profits taxes

(*n*) Bond discounts or finance charges

(*o*) Premiums for life insurance on the lives of officers

(*p*) Special legal and accounting fees incurred in connection with reorganizations security issues capital stock issues, patent infringement or anti trust litigation and the prosecution of claims of any kind (including income tax matters) against the United States

(*q*) Taxes and expenses on issues and transfers of capital stock and bonds

(*r*) Losses on investments

(*s*) Bad debt losses and charges to reserves therefor, also expenses of collection and exchange.

(*t*) In general, commercial advertising and commercial selling expenses

Detailed descriptions of the limitations placed on admissible costs along with those restrictions surrounding inadmissible charges deserve careful study. It is these items which stand to plague the government-contract holder as their treatment is in variance with what was once established business practice.

Selling expenses represent an outstanding example. The "Principles" note: "As a general rule, the expenses ordinarily recognized as selling expenses incurred for the distribution of the products of an enterprise through usual trade and business channels and methods are not regarded as admissible costs under government contracts. The reasoning underlying this principle is that ordinary selling expenses are not incident to and necessary for doing business with the government. Commissions paid by the contractor are likewise inadmissible because these are directly chargeable to the business obtained on which the commission is paid, and it is manifestly improper for the government to recognize as a legitimate cost a commission paid for obtaining business from itself."

Of particular significance to the aircraft industry which, as a rule, maintains numerous facilities to service its product, is the subsequent explanation:

"There frequently are cases in which expenses termed 'selling expenses' relate in whole or in major part to technical, consulting, and other services of application and adaptation of products to the uses and requirements of the customer, rather than merely to simple salesmanship. . . . Men who are nominally or actually attached to the sales department but who are primarily technicians and product engineers render services quite as important and necessary when products are sold to the government as when they are sold to other customers. In such cases before a sale can be effected some problem of application or design or capacity often exists, and must be solved by the field representatives, backed up . . . by a suitable technical organization, before the customer can place his order correctly, and obviously in these cases the selling effort is a minor part of the service performed. For this reason it is not possible to lay down a categorical rule that all expenses called selling expenses are inadmissible costs. The decision as to admissibility depends upon judgment and knowledge of all the pertinent facts and circumstances."

"The same considerations obtain with respect to the expense of maintaining offices and agencies in various territorial areas. The decision as to admissibility of these costs in whole or in part very probably will be largely influenced by the functional nature of the representatives working through them . . ."

With frequent changes made necessary by circumstances beyond its control, the aircraft industry is given a "break" by the section dealing with so called defective work:

"There may be included as an item of admissible costs the net cost of spoiled, defective, or otherwise rejected work to the extent of the natural and ordinary run of mistakes, mishaps, or misunderstandings, due recognition being given for government demands for abnormal rapid expansion of production. Extraordinary losses of this kind resulting from negligence and which could have been avoided by the exercise of reasonable and usual care and diligence . . . may be subject to limitation or exclusion."

It is particularly noteworthy that all forms of federal and state income and excess profits taxes and sin taxes are not proper costs under a government

(*Turn to page 313*)

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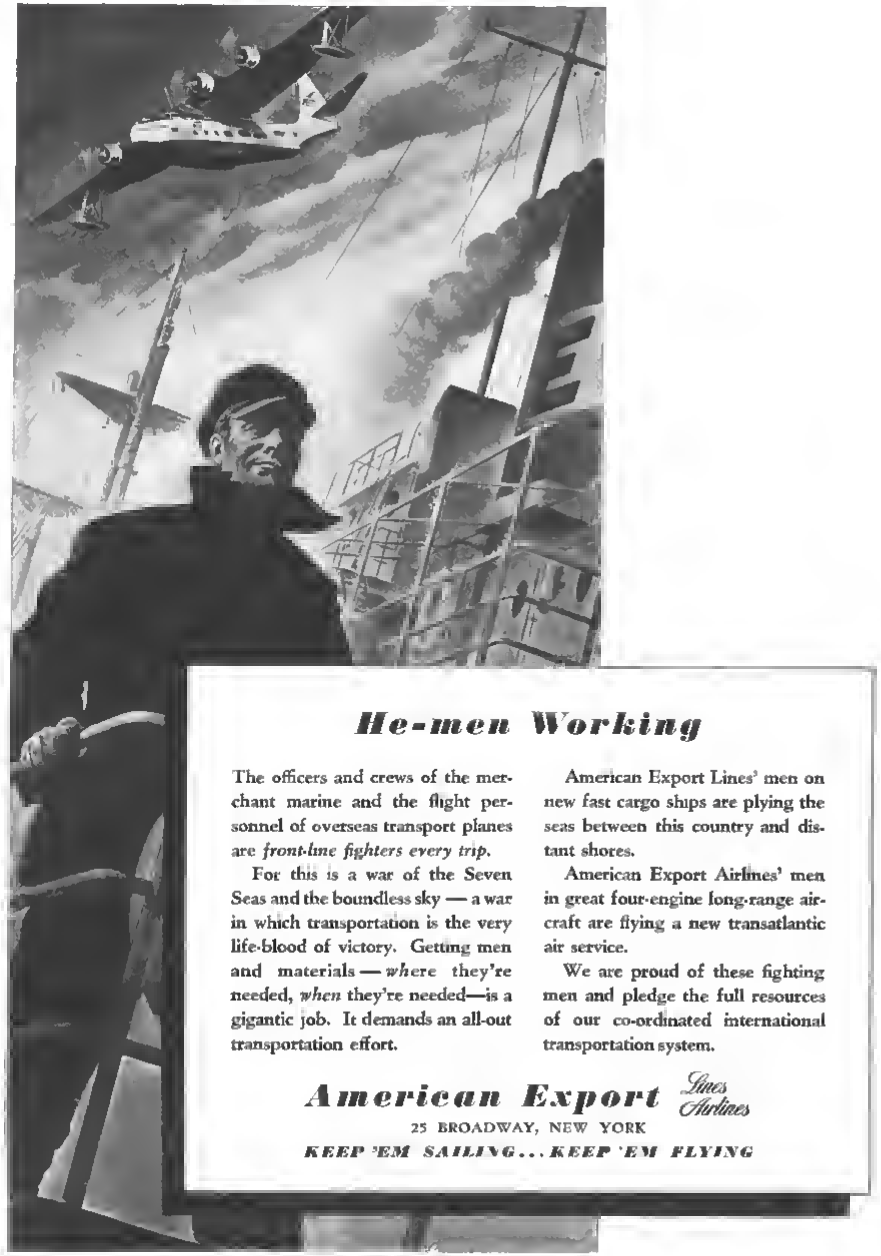
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contract This provision alone makes it certain that regardless how liberal the interpretation applied to the regulations of T D 5000, the so called 8 percent profit top is virtually impossible of attainment.

Interestingly enough, contracts or subcontracts for scientific equipment are exempted from profit limitations of T D 5000 Such contracts must be so designated by the Secretary of the Treasury and pertain to scientific equipment used for communication, target detection, navigation and fire control. Many companies associated with aviation work come under this classification and may be expected to take advantage of this exemption

When the airlines began to assume various assignments for the War Department, the carriers performed their tasks first and talked about compensation later The final result was that T D. 5000 was made to apply in all cases where any contractural arrangements were entered into by the air transport operators and the Army Air Forces. Accordingly, when TWA's Intercontinental Division was the first domestic carrier to assume special assignments for the Army, no basis existed for its compensation but subsequently T D 5000 was made to apply

Similarly, existing contracts between the individual airlines and the Air Transport Command of the AAF are all subject to the same Treasury regulations This not only covers ferrying operations all over the world, but also includes training programs, modifications and gun installations on military planes and all other activities performed for the War Department On all this activity, the airlines are expected to experience small profit margins which may be decidedly short of the 8 percent limit In passing, however, it must be noted that the airlines are acquiring the most valuable prize of all—the intangible experience which will give them a profitable headstart on competitors in world-wide air service after the war

Returning to the aircraft industry, it can easily be seen that in effect, renegotiation of contracts has been a constant process largely through the operation of T D 5000 and represents no new development

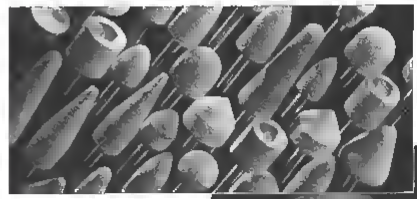
As government officials themselves have indicated, it is not the intention of American industry to reap undue profits out of this war For example, excessive profits, returned to the government, have occurred because of lack of foreknowledge, when contracts were let, of what the costs of a new war product would be under conditions as they prevail today Profit margins vary with volume of production Generally, unit costs decline as volume rises A permissible profit margin is usually less on large volume that it is on small volume

Hence, renegotiation of contracts, regardless how inspired, is really a tribute to the mass production proficiency and progressive technology of American industry Numerous war contracts for aircraft were rush-order jobs when there could be little advance estimating of accurate costs and which only actual experience could supply in a realistic manner

While the Price Adjustment Boards may be expected to exert an important influence in the renegotiation of contracts, it must be remembered that it is the basis principles and cost elements as defined by T D 5000 which set the pattern for revision or re-appraisal of costs

No discussion of this subject would be complete without noting the present government authority to renegotiate war contracts for a period of three years after the end of the war. This provision leads to considerable uncertainty as any company performing war work has no assurance that its books of account will be declared accurate by any subsequent determination that may be made

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It is therefore encouraging to observe that the chairman of the Senate Finance Committee has flatly urged the repeal of this indefinite feature pertaining to renegotiation of contracts. At worst the period after which contracts may be renegotiated promises to drop from three years to one year. Thus the most disturbing element in estimating corporate earnings and in planning for financial needs may soon be eliminated or vastly ameliorated.

In the meantime, T.D. 5000 continues on its way in maintaining an effective ceiling on profits realized by the aviation industry on all work performed for the government.

Water-based Planes

(*Continued from page* 123)

were introduced, usually by air "ventilator" tubes from deck to step (Fig. 12). I have made many such experiments myself and results are usually quite unenformative, I have known apparently exactly similar tests to produce quite different results, presumably because unknown variables keep sneaking in.

On all these points it is fair to say that nobody knows anything useful, qualitatively, about any of them. All we do is to try and get their composite effect from tank model tests, and then pray that the full scale machine will behave according to the corrections we make. Possible we know enough to surmise in which *direction* to try corrections, but no more.

One must make these deductions when the afterbody was just a little tail float it at least behaved itself by not interfering with the action of the main planing surface. Now it interferes to so complicated an extent that nobody knows just what its all-round effect is. Therefore there should be no afterbody; this means that the hull bottom should finish where the planing surface finishes and that there should be no "step" at all. Therefore static and dynamic trim must be governed without reference to a "step" or its location. As this can be done, and as this also suits aerodynamic requirements, it is an inevitable development. It would probably have been done long ago if we had worked on a basis of elementary hydroplaning instead of trying to develop an ancient and accidental freak of shape.

Porpoising

Porpoising is a pitching oscillation during hydroplaning. It is worse than that. It is a destructive and dangerous phenomenon for which no adequate and definite cure has been devised. In the

(*Turn to page* 317)

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The Boeing School of Aeronoutics, o division of the United Air Lines, hos converted its focilities entirely to militory troining purposes, ond hos suspended commerciol instruction for the duration



In the first presentation of its kind ever made, the United States Army Air Force Technical Training Command recently awarded the merit pennant illustrated here to the Boeing School of Aeronautics for "outstanding service in schooling Army Air Force mechanics and technicians during the past two years. This pennant, comparable to the Navy's famous "E" flag, will remain in the possession of Boeing School for six months and will then be re awarded to the technical training school performing the most meritorious service during the last half of 1942

THIRTEEN years ago, on September 16, the Boeing School of Aeronautics was established at Oakland, California, Municipal Airport, primarily for the training of students desiring flight or ground careers with air transport companies.

During these years the familiar coupon in the advertisements for Boeing School of Aeronautics claimed the attention of many ambitious young men. Those who enrolled and completed their courses have proved that "Boeing Grads make good." All over the world—in more than 100 companies—these trained men have been advanced to positions of responsibility as pilots, engineers, technicians, meteorologists, and mechanics in aircraft factories and every department of airline operation. Already, in the armed forces, Boeing Grads are demonstrating the quality of Boeing training by outstanding performance.

Today Boeing School of Aeronautics is "all out" for war for the duration. The program involves the expansion of the army mechanical training, as well as the addition of flight crew training. When the war is over, Boeing School will be qualified more than ever before to contribute its facilities and training for peacetime activities in aviation.

BOEING SCHOOL OF AERONAUTICS — UNITED AIR LINES — **A DIVISION OF UNITED AIR LINES**

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past few years many large and expensive flying boats have been destroyed, seriously damaged or badly delayed by this water leaping. When prospects of this risk is added to the low relative performance of flying boats, it is not surprising that few designers or operators are any longer very enthusiastic about these craft. Moreover, no longer may the designer get the most efficient hydroplaning he can, he has to give first place to avoiding porpoising.

The recent porpoising epidemic does not mean that porpoising is anything new. We had it now and then in earlier flying boats and seaplanes. And actually many a "non-porpoising" flying boat was merely one whose lightly loaded wings usually got the ship off the water or damped out the porpoising before it became serious. With much higher wing loadings, however, water speeds and forces are now high before aerodynamic forces can cope with them, and when those water forces take charge, as they do in porpoising, there is nothing much the pilot can do about it.

Of fairly recent years steps have been taken to "cure" porpoising. Before that could be done studies had to be made to determine its causes. The result has been a considerable amount of sometimes brilliant mathematical work which, practically, has achieved exactly nothing. One might just as well attempt to calculate mathematically the path of a drunk staggering down the street, the general causes of the stagger are clear enough, but there are involved so many variables whose values are impossible to measure accurately that calculation is hopeless. So now, in effect, we have given up trying to cure porpoising by any established principle. The best we can apparently think of doing is to devise an intricate technique of model testing which (we hope) will predict for us whether the full scale job will porpoise. If the model says the big job *will* porpoise, we cut it about until it says it won't. Finally the model probably says the big job will not porpoise if it is kept within a certain "stable range" of trim, so then we build the big job and just hope the model isn't lying. If, as is always possible, the full scale job does porpoise after all, the ship will be delayed, damaged or crashed, and the design discredited. The designer will then devise a still more intricate model—or decide to stick to landplanes. From all such model tests no serious data have been collected nor any useful principles established.

There are several forms of "porpoising" which are fairly distinct, though compounded of the same general factors.

The main, best known, and most serious form occurs just after the bump, and we will consider this in a moment.

There is a very low speed porpoising such as often occurs when the boat "comes off the step" after landing; this is the same sort of thing that you used to find in fairgrounds where a sort of pontoon carried cash customers down a slope into a pool in which it porpoised to rest—about the only profitable form of porpoising known. This sort of porpoising is usually at too slow a speed to be dangerous, and we can neglect it as unimportant.

There are at least three apparently distinct types of high-speed porpoising. Two occur around takeoff and the other on landing. One of the takeoff variety occurs when there is "hump" porpoising sufficiently mild for the pilot to keep control over it up to high speed, at which point a wave or swell suddenly overcomes this control. This type is unusual but very dangerous, especially as it may not be evident for some time.

Another high speed form occurs when the conditions are such that hydroplaning lift is high compared with wing lift, so that the hull is ready to leave the water before the wings are ready to carry it. Under such conditions any water irregularity applies considerable force, and if this force has an appreciable couple around the CG, a porpoising motion results. This, in itself, is usually not dangerous since the pilot has ample air control over it, but what often happens is that this motion is rather rapid and, in trying to overcome it, the pilot institutes his corrections and gets into phase instead of out of phase, thus making things worse. On many flying boats you can get this experience for fun on a down-wind takeoff, and it is very similar to the type of porpoising encountered in speed boats.

The landing type of high-speed porpoising is demonstrated, in various degrees of offensiveness, by a rebound of the aircraft into the air after touching down in an apparently normal landing. This can be caused by "step suction" as described earlier, or it can be due to wing-hull angle combination the effect of which is that, on the takeoff, the hull is kept within its "stable range" of angles but, upon landing, the hull strikes the water at an angle detailed by the wing and, this angle being in the "unstable range," the hull bounces accordingly. Of course since "step suction" is certainly part of the instability involved, the two causes really amount to the same thing. They are also effectively the same thing as the first-mentioned case of high-speed porpoising referred to above, and hence are merely forms of "hump porpoising" which has not become effec-

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The X Manufacturing Company, one of the largest gun builders in the United States, ran smack into serious trouble in the honing of their three-inch and five-inch gun barrels. The honing was being done in two operations—roughing and finishing—during which approximately .011" of stock was being removed. The trouble lay in excessive heat being generated within the barrels. The heat was so terrific company engineers had to pour oil on the outside of the barrels throughout the honing operation. Not withstanding this, the heat caused considerable distortion and many of the barrels had to be straightened and rehoned.

Furthermore the heat limited the honing machine to a steady run of only 15 minutes after which the barrels had to cool for two hours before inspectors could start gauging the gun. Average time required to hone a barrel ranged from 4½ to 5 hours.

A Mid-West engineer was invited in. He found the hones the company was using were too hard. They were "loading up," chipping along the edges, generating excessive heat and creating an altogether unsatisfactory finish. Following a few experimental runs with other stones he recommended the MID-WEST 180 52X hone for the rougher and the MID-WEST 500 98X hone for the finisher. These stones were adopted with this result:

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That is but one instance in which MID-WEST Micro Bond honing stones have helped to save time material and money and increase production—all vital contributions to our war effort. There are many others. Why not ask our engineers—located in most large cities throughout the United States—to tell you about them? Ask them about Micro Bond, the remarkable new abrasive developed by MID-WEST that has "given a new prod to production." Or mail in the coupon printed herewith. Let us help YOU with YOUR honing problem.

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tive until high speed These conditions are usually successively handled by landing at excessive speed in order to put the hull down at a flat and stable angle—incidentally enabling the step cavity to be vented to the rear instead of being shut off by the afterbody It can often be met by changing wing to hull angle so that the wing stalling angle corresponds to the hull stable trim angle

The principal and most serious form of porpoising occurs just after the "hump" At this point there is a relatively sudden change in planing conditions, starting from a high trim angle, where water speed is high enough for water [illegible] air speeds are still too low to have much controlling effect To try and follow through the various motions involving stability and instability would be too long a business, so we must confine ourselves to examining the forces involved

Apart from inertia, there are two main forces: hydrostatic and hydrodynamic If you push a tennis ball (or a boat hull) lower in the water than its normal flotation position, *hydrostatic* force will cause it to bob up and down until it returns to its original position If you skim a stone (or a boat hull) along the water, *hydrodynamic* force will support it, or even throw it out of the water, according to the speed and angle at which it meets the water

If you look at Fig 4 again you will see that, under pure hydrodynamic forces, a hull or float should plane stably, because any force behind the CG turns the nose down and introduces a corrective force ahead of the CG and vice versa. This, in fact, is what ought to happen to our waterplane hull, because these forces could be so disposed as to prevent or oppose the introduction of excessive hydrostatic forces. But with the peculiar brand of hull bottom which we have chosen to standardize, this action has only a limited chance to be effective, while a large number of factors are allowed to hinder or destroy it Since the planing bottom must terminate (at the step) close behind the CG, this positive corrective effect can only occur in the straight section ahead of the step Behind the step the afterbody can only come into play after an excessive trim angle is reached, and practically all this porpoising starts from too high a trim angle When the afterbody does come into action it may do anything from a violent to a mild correction or, in the case of "step suction," it may act negatively, all of which is quite unpredictable, as we discussed above.

Thus, when the hull returns to a lower trim angle from too high a trim angle, inertia may cause it to overshoot the corrective possibilities of the forebody or it may never reach them. Such trim variations alter the hydrodynamic lift characteristics and the hull rises and falls introducing hydrostatic forces which may be acting anywhere around the CG, and thus cause more pitching and more trim variation The greater the deadrise, the more our hull can "dig in" hydrostatically and thus the more it will rebound Then there is the engine thrust and the height and angular travel of the CG to consider—and a few more variables besides Even a change in wing-flap position has been known to smash up the most "stable" flying boat by introducing unsuspected porpoising.

In brief, what you have is a one-way stabilizing system with one sole definite stabilizing factor the straight section of the forebody with large potential forces ahead of the CG and almost none behind it Of the other factors, some are definitely unstabilizing and the remainder may be doing anything at all Basically the trouble is the result of the step and afterbody system and the real problem is not "what causes porpoising?" but "why isn't there more of it?"

In the days of Lilienthal and the early gliders, longitudinal stability and control was achieved by the primitive method of adjusting the "pilot's" weight relative to the supporting surface Then

(*Turn to page* 321)



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DOG FIGHT
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Cherry Blind Rivets will fix it *Fast!*

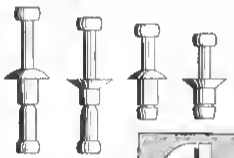
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In addition to field repair, millions of Cherry Rivets are used to speed production and save money in America's aircraft plants when blind or hard-to-get-at spots are encountered in new structures Complete information will be sent on request.

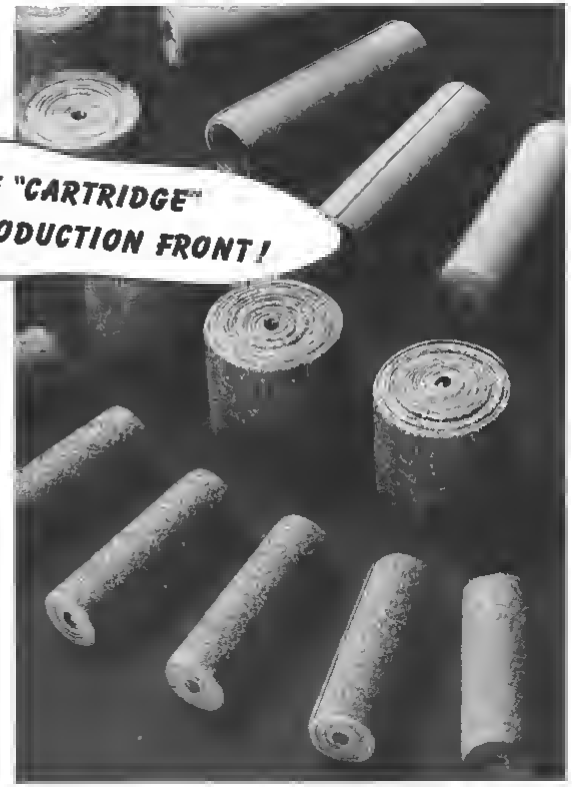
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From left to right, the self plugging type with brazier head countersunk heads—the hollow type with both styles of heads.

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The cartridge roll operates much like a mounted abrasive wheel but has the added advantage of being somewhat resilient It is also economical and long-lived As the abrasive surface wears down the cloth backing can be unwound and torn off to expose a fresh layer of abrasive

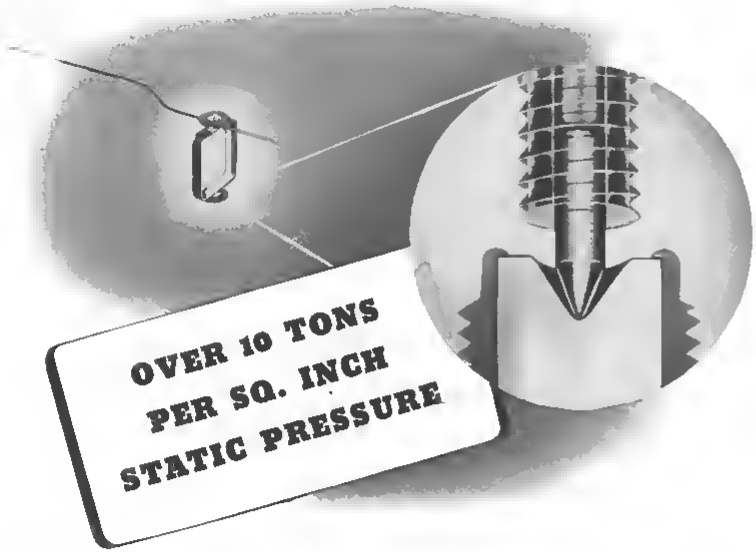
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How is it possible for WESTON so successfully to forestall friction in instrument bearings when the combination of design factors is so critical?"

First let's look at these factors. The bearing may measure only 3/32 in dia. The tiny steel pivot supporting a moving coil weighing only 1/100 ounce, may have a point several times sharper than the finest needle. The static pressure between them will exceed 20 000 lbs. per square inch, and the starting torque may be only the result of minute energy produced by a few microamperes. Yet that pivot must swing freely perhaps millions of times during the life of an instrument.

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it occurred to people that an aerodynamic problem should be solved by aerodynamic means, so tails and elevators were fitted, which could provide predictable results. But, in our hull planing bottoms, we prefer to stick to the primitive weight adjustment system—which is almost all our step changes amount to. In spite of the seriousness of our troubles, we have not acquired air control over our water forces and yet no attempt whatever has been made to secure specific hydrodynamic control over a hydrodynamic action. Which brings us to the subject of hydrofoils.

Hydrofoils

These are "wings," acting basically on the same principles as airplane wings, but operating in water instead of air. Since water is about 830 times as dense as air, it follows that, other factors being equal, a given load can be carried by a hydrofoil of 1/830th the area of an air wing. So hydrofoils have always looked like a useful possibility for improving waterplanes, especially for hydroplaning and takeoff run.

For many years, on and off, they have cropped up experimentally for both speed boats and airplanes. They have been tried for motor torpedo boats. Little or no progress has been made, as is shown by the fact that it is now over 30 years since Guidoni actually flew an airplane from water with hydrofoils (See Fig. 13). Only recently, however, has any amount of serious research work been done on their characteristics, and the suggestion is again being raised that they may be useful in enabling waterplanes to take off with heavier loads by virtue of their generally high lift-drag ratio.

The more obvious reasons for their lack of progress can be at once stated. They do not help the flotation situation, so that either we are still left with the same excess bulk of hull or retractable flotation must be developed with them. They are highly vulnerable as regards fouling or damage from submerged objects including (seriously) fish; at high speed, any bad dislocation of the symmetry of their lift and drag might prove even more catastrophic than a burst tire on a takeoff run, and somewhat more likely. As main carriers of load on water, they would have a large percentage of the weight and problems of the land gear.

For those who want to consider less obvious problems and possibilities of hydrofoils, several points have to be noted. As distinct from the airfoil, the hydrofoil operates in a medium which has a definite upper limit—the water surface—which it must approach, reach and pass; below that surface, the density of the medium remains constant while pressure is directly proportional



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CINCINNATI, OHIO, U.S.A.

to depth so that flow around the hydrofoil, and hence characteristics of lift and drag, vary appreciably as the hydrofoil rises or descends and radically as it reaches the surface.

With all this is associated the problem of cavitation. This problem, well known for a long time to designers of speed boat propellers, is closely related to the compressibility-shock phenomenon of airplane wings at very high speeds: the water flow detaches itself from the upper surface of the hydrofoil, leaving a "cavity" of water vapor. This results in severe and somewhat sudden reduction in the efficiency of the hydrofoil with probably bad vibration. Unfortunately, also present available information (which isn't much and may be improved upon) shows that this commences at a speed which, for modern waterplanes, is very low. This speed may be raised by research, against which must be offset prospective imperfections in the full-scale job arising from construction, maintenance or fouling.

Then we have to consider whether we expect the hydrofoil to function totally immersed throughout the planing run, or whether it shall be partly immersed and partly surface operating (as can be done if we use a multiplane arrangement or steep dihedral) or whether the hydrofoil shall be immersed at low speed, rising to surface-operation at high speed. These considerations will greatly affect general design.

These factors obviously lead to much study and discussion, but personally, taking one thing with another, I am not optimistic as to either the possibility or the desirability of using hydrofoils as a main means of hydroplaning.

On the other hand I do see wide possibilities for their use in promoting hydroplaning efficiency as auxiliary surfaces for the regulation of stability and trim. In such a capacity their most useful features can be applied and their most doubtful features rendered unimportant. Lacking test data of a practical nature it would be unprofitable at this point to speculate on specific prospective applications of these possibilities, but I would venture the suggestion that this could be made a comparatively easy problem. At worst they show prospects of establishing definite principles of trim regulation which our present methods never have done and never will.

Camouflage

(*Continued from page* 105)

from the air the organic structures in the earth which weaves itself like a tapestry across the map.

Further, the camouflageur must be familiar with the type and construction of

(*Turn to page* 325)



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WILCO ELECTRICAL CONTACTS and THERMOSTATIC BI-METALS

(Continued from page 322)

buildings surrounding the factory. He must know what kind of foliage grows in the immediate area and when it is in full leaf, when the branches are naked, when the sun and fog and rain are most likely to bring about the critical condition of exaggerated visibility.

Clearly, all sections of the nation are not alike in soil, topography, and foliage. It is impractical for a designer working in one city to direct camouflage theory and procedure for defense plants in a variety of local scenery scattered from Seattle to Boston, and from Pensacola to San Diego.

Perhaps among the most important weapons of concealment architecture are color and texture. Use of special paints compounded for low visibility and other factors to be later discussed, plus nets, artificial and natural foliage, earth—and a vivid imagination—combine to render effective camouflage.

Contrary to prevalent opinion, it is not necessarily the camoufleur's function to hide or eliminate the factory from enemy eyes. One of his most important jobs is to confuse. It would be possible, with sufficient money and time, to hide completely many a plant, but most authorities, in computing the speed of an approaching bomber and the limited time which the bombardier has to find his target, agree that so-called total camouflage is not essential in many instances.

Because camouflage is a three dimensional problem, it is almost universally studied by the means of a miniature. This necessity is dictated by the fact that sunlight and shadow are ever changing and a two-dimensional scheme does not solve this telltale factor.

Today, when a camoufleur is commissioned to design a "cam job," he immediately confers with local civilian defense authorities, plant owners, adjacent property owners and the army command. From air photos and sketches he painstakingly builds a scale model of the area from which to work out the solution to his problems. These are sufficiently accurate that their public display would be against the nation's best interests.

However, the writer was recently commissioned to build a pair of hypothetical models, from which the illustration for this article were taken. These models were prepared for Premier Oil & Lead Works of California, developers of a spectacular infra red, heat deflecting camouflage paint on which the author relies for many effects. Together the models show the scene before and after a comprehensive camouflage design has been applied to a factory and its environments.

The center of interest is a large American factory, which we shall call the Greenhill Manufacturing Co., embodying all of the types of buildings to be found in nearly every kind of industry. Let us further assume that this factory exists on a river. On one side of the plant are main line tracks and rolling tree-dotted hills, on the other, the edge of an average size industrial town. It has several pronounced landmarks including a bridge, dock, slips, parking lots, storage tanks and numerous other reference points.

Across the river is a small town with nearby farms, and a curving highway which is normally used to transport farm produce and tourists, rather than industrial trucking.

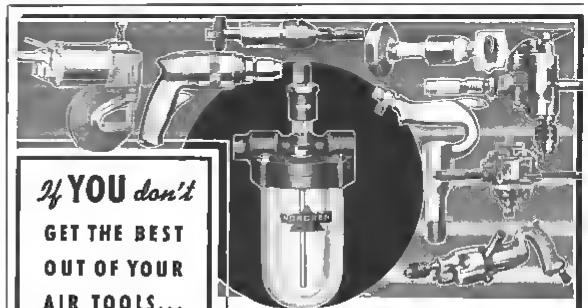
All the difficult problems that beset a camoufleur have been included in this one example. It is to be hoped that very few plants would incorporate all of these trying problems.

To camouflage only the factory would not have been intelligent practice. If the enemy expects to find the target in a certain location, he will be suspicious if none is visible. He will study photographs carefully and quickly find the exact location of the hidden plant.

To hide or obscure adjacent reference points even several miles away is as necessary as to do so to the target itself. If the enemy is to be kept from rapidly penetrating our mask, we must resort to area camouflage. In this model, it will be seen that we have taken full advantage of common physical characteristics of the river above and below the actual target.

Of course, in a real problem, such total camouflage can only be accomplished with the understanding and cooperation of everyone in the target area. At least 35 percent of the effectiveness of camouflage depends upon what is known as "camouflage discipline," or the willingness of everyone in the area under observation to abide by a set of rules. These may include such widely varied requests as the prohibition of smoking chimneys, the abandonment of certain roads, the constant maintenance of slime-reducing or glare-reducing properties on railroad tracks and high tension wires, the organization and distribution of traffic at certain hours, the parking of cars according to a preconceived plan, the frosting of certain windows to eliminate sunset and sunrise glare, and hundreds of other inconveniences that may be visited upon the people in the entire area surrounding the target.

In this model a large portion of the factory, administration building and



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numerous plant buildings, was "broken up" by painted surfaces giving the appearance of smaller buildings from bombing altitudes. The shape and height of smokestacks were minimized by light weight irregular-shaped wood and cable fins attached about halfway up the stack and painted to blend into the surrounding design.

In dealing with the shadow problem, it can be seen that paint alone is not enough. Paint needs must, after all, a three-dimensional, structural sun-reflecting and shadow casting job. Light must be introduced into shadow areas and incidental shadow areas introduced back into light areas.

Long, straight, persistent shadows cast by rows of buildings must be broken up by these structures. Then construction must be such that only its effect, or visual properties are visible from the air. Methods of supporting and maintaining these shapes, nets or canopies must not be seen. No matter how clever and how real a forest may look, a photographic interpreter is on the lookout for telltale signs that will reveal man-made construction.

The type of construction must, of course, be cheap, fireproof, waterproof and windproof. It must be light in weight and have a certain amount of elasticity. Hard boiled construction looks static and stiff from the air. Plant encampments, consisting of tents, moving a little in the breeze, is more desirable.

This construction must also be designed with a view toward maintenance. If the war continues longer than optimists say, it may be necessary to renew paint from time to time. And, of course, there are the changing seasons which in some climates present a continuous maintenance problem.

The appearance of forested areas in the camouflaged model is made possible by use of nets and flexible wire mesh on which colored, tattered cloth and kindred material, known as garnish are draped. The whole is then painted according to a pattern.

In an effort to make a flat surface take on protuberances and depressions, it helps to take advantage of the high and low visibility property of certain pigments. It is not done by contrasting values alone, but by the use of colors and shades of widely separated specular visibility. Brilliant primary colors of high visibility used next to background colors of olive drabs and grays will seem to pop in, stand out, giving the appearance of relief. This can be seen in studying textile designs of indifferent color choice. Often you will find bad combinations of colors which result in optical vibration and an erroneous conception of depth and dimension. Careful study of this phenomenon enables the camouflage to simulate structures in relief on a perfectly smooth surface without resorting to tricks of perspective which are effective under some conditions and from certain viewpoints but are completely in error from others.

The combination of deception removal of shapes and substitution of others, alteration of appearance of highways, bridges, and parking lots—all were accomplished in this model with out hindering the normal production of the plant or flow of surrounding traffic.

Of course, there are all degrees of camouflage besides the costly total camouflage which these models demonstrate. There are numerous places where the train and highway sheds melded here, and necessary to continue the finest design, would not be practical. Yet, primary camouflage with paint alone is frequently considered enough to confuse the approaching bomber until an anti-aircraft barrage can come into play.

No single mechanical consideration is more important to the camouflage than paint. For no matter how successfully camouflage hides the plant from the bombardier's eyes, one must remember that he is equipped with highly technical photographic apparatus which is designed to penetrate paint and net camouflage.

It does this by means of color filters and infra-red film, which betray man made and man painted imitation vegetation and other surfaces.

To overcome this weakness, alert paint manufacturers have been on the job. Today there are available camouflage paints that react to all known photographic and sensitometer tests precisely as does natural foliage. This one advancement in technology has been an immeasurable aid to camouflagers throughout the land.

These new infra-red reflecting properties have also increased the durability of paint, as well as making possible reductions of inside temperature of the object painted by as much as 15 deg.

In this connection more details might well be given about what we have learned to require of camouflage paints. Frankly, the technical requirements of these paints are such as to virtually nullify the camouflager's efforts if they are not met. The architecture of concealment is worthless if it interferes with the normal production capacity of the plant to which it is applied. This means more than merely avoiding fastening nets and fabrics where they will be tripped over, it means retaining as pleasant and efficient working conditions as possible by specifying a heat-resisting camouflage paint to replace the gleaming aluminum paint widely used to deflect heat. More than a mere notion, this paint was proved decisively in the first ten "beam jobs" which were constructed in America after Dec. 7.

Responsibility of the executives and management of American industry is clear. They must see that America's equity in their business is protected. Too often after reading the morning paper about how clever the Japs or the Nazis have been in concealing and protecting their centers of production, we mistakenly condemn our own army command or civilian defense officials for lack of foresight in protecting ours.

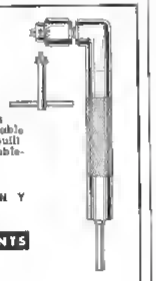
Camouflage is like a bike. Its purpose is to keep the river of destruction away. Cairo, Ill., does not resent the cost involved in building her huge levees, because every spring she sees the water level above her housetops held back only by 20 yards of dirt and concrete.

Cairo didn't build her first levee until she had been inundated by flood at least twice. War production cities and plants should not wait to start thinking of and providing camouflage until enemy bombs have been heard and felt. Then it might be too late. It is as necessary to protect the productive capacity of our plants as it is to protect our shores against invasion, and there are many people vitally interested in helping solve these problems in the architectural, structural, paint, and material field of American industry.

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ABOVE LEFT: The British have called the Lockheed Hudson the outstanding aeronautical achievement of the war. This American-built medium bomber has been called upon to perform practically every type of task necessary to win a war . . . ABOVE RIGHT: Medium bombers are as necessary to win a war as are the heavies, and in this category American planes have no equal. The North American B-25 Mitchell' has performed admirably on many fronts. Brig. Gen. James Doolittle gave Tokyo residents close range views of the planes and ample evidence of their precision bombing ability . . . ABOVE: Versatility of American medium bombers was demonstrated during the Battle for Midway when Martin B-26's appeared, with devastating results, as torpedo carrying planes. Known abroad as the "Marauders," they have long given an excellent account of themselves on European and African fronts.

The Truth About Our Bombers

(Continued from page 97)

As to bomb carrying capacity, the *Lancaster* has a decided edge. The total fully loaded weight of the *Lancaster* is given as approximately 60,000 lbs. A maximum bomb load of approximately 8 tons can be lifted. Thus, the *Lancaster* has a maximum bomb load of 8 tons against approximately 4 tons for the B-17.

Thus, in but one of four qualities does the *Lancaster* appear to have an edge on the *Flying Fortress*. It is no faster—quite probably not as fast; it has no more range—quite probably not as much; its firepower is not as great; its armor appears to be no better; but it can carry a heavier bomb load.

In this connection, one vital point should be kept in mind, however. The *Lancaster* has been developed for one purpose: mass night raids over Germany. The *Flying Fortress*, on the other hand, has been developed to meet vastly different and varying conditions—just such conditions as today's war calls for—fighting on fronts all over the world from all types of fields, putting the bombs exactly where they are needed.

In precision bombing, for which our planes are designed, American craft have no equal. One vital feature of this superiority, aside from the unequalled bombsights, is the exceptional stability of the planes at extremely high altitudes, a stability made possible by development of the turbosupercharger. Germany undoubtedly has an effective supercharger, but to date America appears to have a decided edge, one which will be increasingly effective with continued expansion of its Air Forces. This stability for bombing runs cannot be underestimated, for American planes have been designed and built on the theory that it is better to plant 4 tons of bombs where they will hurt the enemy the most than to drop greater loads over a wide area with, perhaps, less than 4 tons hitting the target.

On this point, an examination of the record indicates that this widely heralded theory is destined to play an increasingly important role in this war.

Mr. Peter Masefield has been quoted as writing in the *Sunday Times* of London that "it would be a tragedy for young American lives to be squandered through assigning either *Liberators* or *Flying Fortresses* to raids into the Reich night or day."

That was the day before Brig. Gen. Ira C. Eaker, chief of the U. S. Bomber Command in England, led 18 *Flying Fortresses* on a daylight attack on Rouen, Dunkerque and Cherbourg, hitting the targets. All 18 planes returned to their bases.

Two days later 23 B-17a made a daylight attack on German airports at Abbeville while Commandos were landing at Dieppe. All 23 returned to their bases.

The following day 12 B-17a, returning from a mission over the North Sea, were attacked by between 20 and 25 Focke-Wulf 190's, the latest and "hottest" fighter plane in Hitler's Luftwaffe. The score: three Focke-Wulfs definitely shot down, nine probably destroyed. All twelve of the B-17a returned to their bases.

On Aug. 24, three days later, German shipyards at Le Trait, France, were bombed during daylight by *Fortresses*, all of which returned to their bases.

Again, three days later, *Fortresses* made a daylight foray against German shipping at Rotterdam, putting the bombs where they did the most possible damage. All the *Fortresses* return to their bases.

The next day—again during daylight hours—B-17s bombed an aircraft factory at Meaulte, near Albert, France. Again, all the American planes returned to their bases.

The following day a force of B-17s bombed a German-held airport at Wevelghem, Belgium. All the *Fortresses* returned to their bases.

Eight daylight, precision bombing raids without the loss of a single plane. In fact it was not until Sept. 7 that any *Fortresses* were lost, on that day two failed to return. The record of these so-called "inferior" planes making daylight raids contrasts sharply with consistent 5 to 10 percent losses of other Allied bombers during large scale night raids. It contrasts even more sharply with the record on which the *Lancasters* made their debut and, it would appear from press reports, much of their reputation: that against Augsburg when seven out of twelve did not get back to their bases.

This record of American bombers, which is only the beginning, has been built in only one theater of operations. But any comparison of bombers must consider one vital fact: that this war is being fought all over the world.

Examine, then, the record in the Pacific. There the Japs labeled the *Fortress* a "four engine pursuit ship." Aside from the cold fact that more of the vaunted *Zeros* have been shot down by *Fortresses* than *Fortresses* by *Zeros*, American planes won the Battle for Midway.

There, it will be remembered, two strong Jap forces were converging. One was a sea and air attack force, the other a land attack force. American bombers, American torpedo planes, American dive bombers and American carrier fighters kept those two forces from converging, kept them even from coming within range of American surface vessels. Not the least of the American striking power in that battle was contributed by four engine bombers. And in that battle, it should be remembered, nothing but precision bombing was of value. There the targets were small, they were moving; they were not cities and sprawling industrial plants rooted in one place.

From the record it would appear that American heavies are doing all right in competition with the best in England. But any comparison of bombers must recognize that there is more than one category necessary to win this war which brings us to the medium bomber.

First to come to mind, of course, is the American built Lockheed *Hudson*. Many of these have gone to Britain where they have done practically every type of work—and done it well—that anyone could ask of a plane. The British themselves have called the *Hudson* the "outstanding aeronautical achievement of this war."

Not to be overlooked, however, are the North American B-25, which the British call the *Mitchell*, and the Martin B-26 known in England as the *Marauder*. The Japs know both types very well, the B-25s which Brig. Gen. James Doolittle showed them over Tokio on his trip from Shangri La and the B-26s which appeared off Midway as torpedo carrying planes.

The most significant fact about American superiority in medium bombers is this: England is reported discontinuing production of her own line of twin-engine bombers with no new ones "in the works." There are no reports, however, of the American built B-25s and B-26s now in service being given up and production of them is being increased presumably to supply all the United Nations.

As to light attack bombers, perhaps nothing more than this need be said: the British use the Douglas A-20, which they call the *Boston*, as a night fighter as well as a short range bomber.

No fair-minded American will deny that the British heavy bombers are good. For large-scale night area raids on Germany the *Halifax*, the Short *Stirling* and the *Lancaster* are undoubtedly without peers. But this war requires more than one type of bomber. Therefore, no American need believe that our equipment is inferior. For long range precision daylight bombing—which is as necessary as mass night raiding—our Boeing *Flying Fortresses* and Consolidated *Liberators* are more than holding their own. For medium and light bombers—both categories as vital as the heavies—the Lockheed *Hudsons*, the North American B-25s, the Martin B-26s and the Douglas A-20s have no equal in any man's air force.

Sweeping statements that American bombers are inferior should be taken with more than one grain of salt.

Total war requires light as well as medium and heavy bombers. In England the American-built Douglas A-20 not only serves as a bomber but has been equipped with extra guns and turned into a very effective night fighter, a high tribute to its speed and maneuverability.





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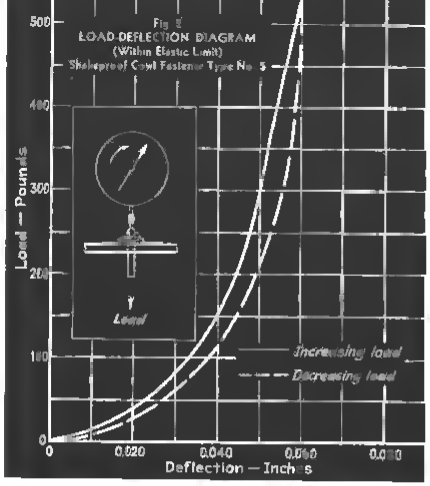


FIG 3 Load deflection curve plotted from test readings during the test of tension within elastic limits

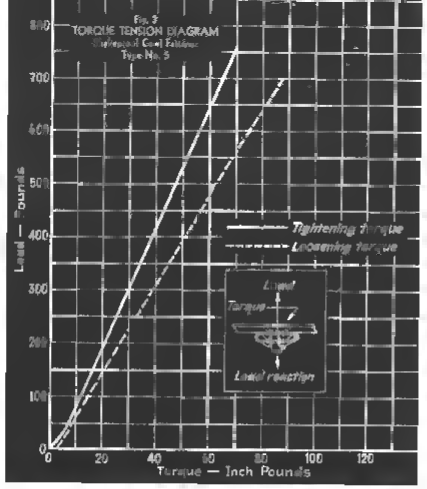


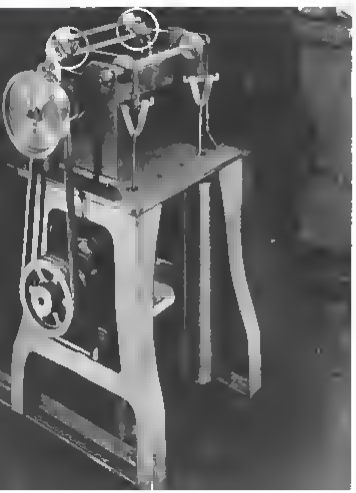
FIG 4 Test of torque-tension relation with torque properly increasing with tension.

Aircraft Cowl Fasteners

(Continued from page 128)

movement of the stud beyond this point is restricted, effectively safeguarding against separation of the sheets beyond the predetermined amount

FIG 5 Vibration test with fasteners mounted at a 45 deg angle and loaded with lead weights through a spring having a frequency less than that of the vibrating machine.



Of the many tests performed, the Fatigue-Endurance test, Fig 4, probably contributed more than any other in pointing out early weaknesses and their possible correction in design, material and heat treatment

The machine used essentially was an automatic device to duplicate the normal locking and unlocking operation of the fastener, turning it off and on many thousands of times Individual screw driver bits operated under spring pressure were rotated at 110 cycles per minute through an angle of 90 deg or more to open and close a series of the assembled units until failure occurred, at which time a reading was taken of the number of cycles of rotation

It is interesting to point out the nature of the improvement at the number of "on and off" cycles withstood by the fastener during the series of tests conducted before the final design was secured In the early tests, the maximum number of cycles the part withstood before failure was 900 This number was gradually increased to 3,400, 9,000, 18,000, 36,000, and finally 60,000 The improvements made to accomplish these increases in the number of cycles of fatigue involved changes in shape, design, thickness, heat treatment and redistribution of stresses.

Vibration

One of the tests which most nearly duplicated actual flight conditions was the study of the fastener under a vibratory stress (Fig 5) Because the severe AN test of 25 hours vibration could not be conducted on an existing machine, a special machine was developed Its design offered complications in that the inertia of a considerable mass subjected to movement at relatively high speed creates terrific stresses on the machine parts. The problem was solved through variations in design of the moving parts, and reduction of the mass to reduce the effects of the inertia

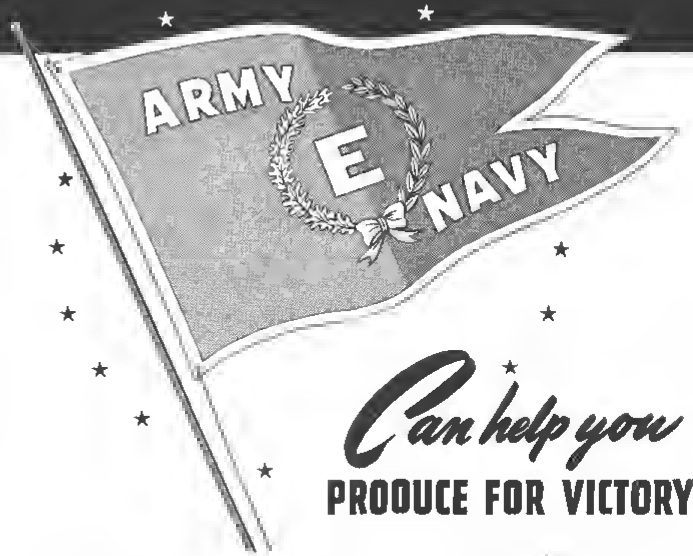
Following the recommended procedure of the specifications, the fastener was mounted on an inclined plane of 45 deg and loaded with a heavy static load through a spring having a frequency less than that of the machine. The latter was vibrated at 360 cycles per minute through an amplitude of ¼ in By recording the torque measurements of the assembled units at various stages of the tests the information obtained assisted considerably in studying the effects of these vibratory stresses upon the parts of the assembly

The torque measurements were made graphically on a recording torque meter. During the vibration tests, measurements were taken at various intervals and during the fatigue tests after every 5,000 cycles

After the test fastener ran through the twenty-five hour vibration test it was subjected to 25,000 cycles of fatigue The residual locking torque of the fastener after undergoing this severe punishment remained approximately 80 percent of the original, a relatively small drop in view of the severity of both of these tests

Army Air Force approval was secured after the successful completion of this long series of tests which represents quite a distance forward from the original design stage

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The Truth About Our Fighters

(*Continued from page 95*)

aircraft and other air units got the remainder. American losses were described as eight pilots missing.

Most significant of all was the achievement of a single carrier-based squadron which accounted for a total of 27 enemy planes. That squadron lost one pilot.

Moreover, there is now in production for the Navy a new carrier-based fighter far superior to existing types. It is the Vought Sikorsky F4U *Corsair*. It is powered by a 2,000-hp Pratt & Whitney *Double Wasp*, which gives it a top speed in excess of 400 mph and an excellent rate of climb and altitude performance.

No attempt will be made to describe the scores of fighter aircraft which are in operation throughout the world. It is our purpose here to clear up the considerable confusion which exists through a factual description of those fighter planes of the major air forces which are significant by virtue of their outstanding performance, their numbers or the controversies which revolve around them.

First, therefore, is the Curtiss P-40 series of pursuit ships. It is a single-engine, low-wing, design with conventional retracting landing gear. It is powered by the General Motors Allison liquid-cooled V-type engine. This engine is manufactured in several types, rated at 1,150 hp and higher. Unless otherwise specified, the rated horsepower of engines will be in the amount of power available for takeoff at sea level.

The manufacturers and designers of the P-40 will admit honestly and freely that during the early stages of this war, about the time of the fall of France, the first P-40's were not adequate in performance or armament as compared with the first-line German and British fighters. No time was wasted. As quickly as the information issued in certain operational experiences at the front could be transmitted to the manufacturer, it was translated into blueprint and change order. These were changes that could be made simply and quickly without retarding production, such as the addition of armor plate, bullet-resisting windshields, and self-sealing fuel tanks.

Those early *Tomahawks* did not enjoy a warm reception in England. There were some obvious reasons for this. The very first ones actually were not equal to the task which the British wanted them to do. There was probably something of the natural reaction felt against a strange dog in the home kennel. Furthermore, during the hectic days of the Battle of Britain the RAF had little time to study and familiarize itself with the foreign machines. The bitter situation was complicated by the lack of adequate service facilities in those early days.

Consequently, the *Tomahawk* entered the Libyan campaign with two strikes against it. But it was soon learned that it was the only pursuit plane available in quantity that would cool properly under those extreme climatic conditions. The Australians, South Africans and New Zealanders took to the *Tomahawk* immediately. As the desert squadrons of the RAF acquired more and more combat experience with the *Tomahawk*, their reports swelled into a steady stream of praise for the American plane.

Meanwhile, the manufacturer, in cooperation with the Army Air Forces and the RAF, was busy redesigning the P-40 on the basis of the considerable new knowledge acquired from wide operational experience. This was the P-40D, a fairly radical departure from its predecessors. The fuselage cross-section was reduced; provision was made for increased armament; and an engine of greater put-out power installed.

The blueprints for this model were hardly dry, however, before additional information and newer requirements made it necessary to engineer a more advanced type as quickly as possible. This resulted in the P-40E *Kittyhawk* which went into production in 1941, and the P-40F *Warhawk* which was in production early in 1942.

These two models are quite similar except that the P-40F is powered by a Rolls-Royce liquid-cooled engine which is being built in this country by the Packard Motor Company.

Before dismissing the earlier P-40 the *Tomahawk*, it should be remembered that they have been more than holding their own in many theaters of the war. The magnificent achievement of the American Volunteer Group in China, mentioned previously, was established with the *Tomahawk*, which is a design two years older than the *Warhawk*—and two years means a lot in the age of a fighter. The layman should also be cautioned against assuming that foreign air forces are made up largely of such superior performing aircraft as the *Spitfires*, *Messerschmitts*, *Zeros* and *Beaufighters*. It would be very enlightening and heartening for the average American to see some of the flying junk heaps which are still doing yeoman service in the RAF and the vaunted Luftwaffe.

We have no intention of minimizing or belittling the foreign air forces in comparison with our own, but it is a common mistake to assume that our own air forces are made up of a lot of inferior planes with a few good ones.

The P-40E's and F's are armed with six .50 in. caliber machine guns, three mounted in each wing. These models have maximum speeds approaching 400 mph, but probably not exceeding it in straight and level flight. In this connection it should be noted that the P-40 can outfly the *Zero* by 100 mph. or more in a dive, despite the fact that the *Zero*'s maximum speed and maneuverability are greater than that of the P-40. This is due to the superior design and more rugged construction of the American plane. The *Warhawk*'s service ceiling, that is, the maximum altitude at which it can still perform effectively, is well in excess of 25,000 ft.

If this altitude performance is not as good as that of other fighters, it is not because the P-40 cannot be equipped to reach high altitudes, but primarily because it is not supposed to. The *Warhawk* could be modified to reach far greater altitudes by the installation of more elaborate supercharging equipment. As soon as this was done, however, one or more of the other desired characteristics of the present version would have to be sacrificed.

It is interesting to note that the British *Spitfire*, though able to perform at far greater maximum altitudes than the P-40, is nevertheless out-performed by the P-40 at certain medium altitudes.

There, briefly, is the case for the P-40. It is not a defense nor is it unqualified praise. It has a particular set of performance characteristics and other qualities not duplicated by any other airplane in the world. In certain respects it is superior to most other fighters. It is consistently winning victories against Jap *Zeros* and even the excellent German Messerschmitt 109. Much credit for these victories is due to the courage and superb training of American pilots, but do not for an instant be deluded into believing that our airmen could continue turning in such brilliant performances if their flying equipment was as inferior as certain irresponsible critics would have the American public believe.

The Bell Aircraft Company's P-39 *Airacobra*, although it has been in operation for a long time, is still a dark horse, as fighters go. It is a single-engine fighter equipped with a 37-mm automatic cannon. It is the world's only single-engine fighter equipped with tricycle landing gear. It possesses many other unique design features.

The most unusual feature of the *Airacobra*'s design is the location of the engine. An Allison liquid-cooled V-type engine is mounted approximately in the center of the fuselage behind the pilot's cabin. This offers a number of advantages considered highly important in fighter plane design. It permits the pilot's cabin to be placed well forward toward the leading edge of the wing, affording maximum visibility with a minimum of obstruction to his view whether in the air or on the ground. An extension shaft from the engine runs along the bottom of the fuselage between the pilot's legs to a gear box in the nose, which drives the propeller. The propeller has a hollow hub and it is through this aperture that the muzzle of the 37-mm cannon protrudes. In addition to the automatic cannon the fighter is equipped with various combinations of machine guns. A common arrangement is two



The Grumman F4F Wildcat, another carrier-based fighter of the United States Navy. This is the Navy fighter mentioned so frequently in dispatches describing the Battle of Midway, the Solomon Islands offensive and other engagements in the Pacific area. Incidentally, the Japs almost never get them.

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However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

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.50 calibre machine guns in each wing and two additional machine guns of 30 or 50 calibre firing through the propeller arc.

It is not enough that an airplane be able to perform well in combat. It is vastly important that it be easy to service and maintain under the most adverse conditions. The *Airacobra* offers some unusual advantages in this respect. The wings are attached to the fuselage at their root, by means of simple fixtures. A single set of jacks is all that is necessary for erection or disassembly, eliminating the need for an overhead hoist of any kind. If a wing or landing gear must be replaced or repaired, no crane is needed; only in removing or installing the engine is such a rig required. This greatly facilities repair and replacement in the field.

The tricycle landing gear feature also has proven a boon to servicing and repair. The fuselage and wing remain in a level position when the craft is on the ground, providing a level platform on which servicemen may work. This is important away from regular bases where work platforms are not readily available.

The location of the engine is also important from the standpoint of performance. The engine, which is the heaviest single part of a plane, is near the center of gravity of the aircraft structure. This means, in simple terms, that in sharp turns or in a pull-out from a steep dive, fewer excessive strains are imposed upon the structural members of the plane.

In this connection it may be stated that American aircraft are continuing to be constructed with ruggedness, high safety factors and reserves of strength almost unbelievable to the pilots and aeronautical engineers of all other countries.

In reports of aerial combat from abroad we frequently read of pilots who are quoted as saying their adversary "exploded" or "flew to pieces" in their gun sights. This simply means that when a cannon shell or burst of machine gun fire struck the enemy plane it disintegrated. This happens very rarely to American planes. A gas tank may explode, their engines may be torn loose from their mountings, their control surfaces may be shot away or shells put through their wings, but they don't "fall to pieces." And very often, they return to their bases in spite of grievous wounds.

Before going on to the later and more advanced American fighter types about which the public has not heard very much as yet, the best known fighters of foreign air forces will be described. The most popularly known are the British Supermarine *Spitfire* and Hawker *Hurricane*, the German Messerschmitt 109 and Focke-Wulf 190 and Jap *Zero*. All of these, with the possible exception of the Focke-Wulf 190, have been produced in a series of different models varying from several to half-dozen. The latest models upon which information is available are referred to unless otherwise indicated.

When England entered the war the Hawker *Hurricane* was her foremost fighter. The Vickers Supermarine *Spitfire* was in development, well along toward the production stage. The further modification and development of both the *Hurricane* and the *Spitfire* was detailed by day to day experience in actual combat and they have proved to be the world's best fighter planes for the particular mission they were designed to accomplish. Both of these fighters are powered by a single Rolls Royce *Merlin* liquid-cooled V type engine. This engine, like its American counterpart, the Allison, has been improved upon steadily during the past few years. The *Merlin XX*, one of the latest models, is rated at 1,260 hp.

Both fighters have low wing design with conventional landing gear. The *Spitfire* has somewhat cleaner aerodynamic design than the *Hurricane*. The top speed of the latest model is in the neighborhood of 400 mph.

The outstanding feature of these two fighters is the amount of fire power packed into them by the British. Everything else was subordinated to the requirement that they be able to take off and climb at a maximum speed to intercept attacking bombers and concentrate a withering fire. To this end, the British installed as many as twelve .303-in. calibre guns in the fighters, six in each wing, and in some versions installed four 20 mm. cannon, two in each wing, firing outside the propeller arc. And was Jerry surprised! It is only now that Germany is beginning to bring out later types of fighters with increased offensive armament.

The *Spitfires* have a very short range, being unable to remain in the air for more than approximately two hours without returning to their bases for refueling. Although their concentrated fire power is terrific, the ammunition carried is only sufficient to last a short while if all machine guns are fired simultaneously. Without detracting from the credit due these fighters, experience has shown that they have not displayed the same versatility and adaptability as American fighters when placed in service under extremes of climate and terrain in other theaters of the war.

The Focke-Wulf 190 is the newest German fighter encountered in the war. It is a low-wing design distinguished chiefly by its aircooled radial engine and inward retracting landing gear of extremely wide tread. Its BMW 801D 14-cylinder engine develops approximately 1,600 hp. It is significant that the Germans have finally switched to an air-cooled radial engine installation in a fighter.

The FW 190's armament consists of two 7.92 mm. machine guns mounted on top of the fuselage and firing through the propeller arc, two 20 mm. Manser cannon mounted in the wings near the fuselage, also firing through the propeller arc, and two 20-mm. Oerlikon cannon also mounted in the wing, but firing outside the propeller arc. The British report that the effectiveness of the fire power is curtailed due to the short range of the machine guns and low muzzle velocity of the Oerlikons.

The plane is well armored. Armor plate is installed behind the pilot's seat and an even thicker plate is fitted behind the pilot's head in the movable cockpit cover. A thick, bullet-proof windshield protects the pilot's head in the front and certain vital portions of the engine installation also are protected with armor plate. This is standard practice, also, in the construction of American warplanes.

The RAF captured one of the machines intact and put it through its paces. They reported its maximum speed was 375 mph at 18,000 ft. It is most effective at altitudes ranging from 15,000 to 25,000 ft. but is a poor performer at lower altitudes. American bomber crews who have met the FW 190's in combat report that it does not handle very well near its reported service ceiling of 37,000 ft. One disadvantage of the 190 is that it glides in at 125 mph and sets down at 110 mph. This is compensated for in some measure by its unusually wide tread landing gear, set well forward of the center of gravity, which enables the pilot to apply brakes freely. Its range is very limited, but as is true with most fighters, provision is made for the attachment of an auxiliary fuel tank below the fuselage which can be dropped in flight after its contents are exhausted.

The FW-190 is ingeniously designed and well built. It enjoys the hearty respect of engineers and pilots of the United Nations Air Forces, but it is very far from being the world's best fighter plane and does not live up to the exaggerated claims made for it by Nazi propagandists.

The Messerschmitt 109 series represents the standard single-engine fighter of the Luftwaffe. It is powered by a Daimler Benz liquid-cooled inverted V-type engine, developing approximately 1,150 hp. The top speed of the ME 109F, the latest model, is approximately the same as that of the FW 190, but it is very deficient in armament. It is equipped with one 20-mm. cannon and two 7.92 machine guns. Both the ME-109 and FW 190 are very maneuverable and climb at 3,000 ft. per min. or better, depending on the altitude.

The Heinkel 113 is another single engine German pursuit frequently mentioned. It also is of low wing design having conventional landing gear and is powered by a Daimler-Benz liquid cooled engine like the Messerschmitt. When it first made its appearance a few years ago, it was tricky and difficult for the pilot to handle, but it has been learned that it was redesigned and the result was good.

Now we come to that great Nipponese mystery plane—the *Zero*. At the outset let it be said that the Jap *Zero* fighter is a fast, high altitude, very maneuverable job, but right there its virtues cease. The record of the battle in the Pacific proves conclusively that these qualities alone are not sufficient to win aerial battles.

The Japanese fighter plane commonly referred to as the *Zero* has been in service nearly two years, possibly a little longer. Consequently, it has as many modifications and variations as would be expected of any other type of combat plane in service for a similar length of time. The problem of identifying a particular fighter is further complicated by the obscure system of aircraft identification used by the Japs.

The Japs take the last two numerals of their calendar year when a plane goes into service and put a "T" in front of it. The Jap calendar begins at the year 660 B.C., so that it is now the year 2602 in Japan. Airplanes which went into service during their year 2600 (our 1940) were designated as T-00, or just plain zero. Several manufacturers produce the *Zero* fighter and each incorporates some modification in design or construction. The *Zero* fighter is produced for the army, a carrier-based model for the Jap Navy, and still another version is equipped with pontoons. In any event, the outstanding characteristics common to all of the *Zero*-type fighters will be described.

The *Zero* fighter is a low wing, all-metal monoplane equipped with conventional landing gear, except for the seaplane version, and powered by an air cooled radial engine. It is somewhat similar to the Focke-Wulf 190 in that it has an inward retracting wide-tread landing gear and a radial engine with a slim tapering fuselage.

The Mitsubishi Kinsei engine which powers the *Zero* has been analyzed by American aeronautical engineers. It is a 14 cylinder, twin row radial, with seven cylinders in each bank. It is equipped with a single stage engine driven supercharger and is rated at 1,050 hp. for takeoff. It is copied chiefly from American engines of similar design, although it incorporates modifications of design features of similar engines of British and German design. It is rated as a highly dependable engine, although considerably less efficient for its size and weight than comparable engines of American manufacture.

The top speed of the *Zero* has been reported as being 340 mph but it is probable that improved models can attain higher speeds than that. Its light construction, bordering on the flimsy, coupled with its low wing loading, enables it to climb at a fast pace and reach altitudes in excess of 30,000 ft. The wings and fuselage of the *Zero* are constructed in one piece. In other words, a damaged wing panel could not be removed and another one attached by a set of bolts as is the case with virtually all American aircraft. This makes for higher weight and faster construction, but it also means that in case of severe damage the entire airplane must be replaced, and it doubtful whether the Japs can supply replacements in sufficient quantities to maintain strength.

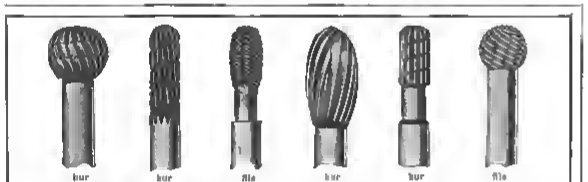
This, and other similar short cuts in design and construction, contribute to the relatively high performance of the *Zero* in relation to its power. The Japs consider pilots and planes as "expendables." Hence, the Jap pilot carries no parachute. He has no protective armor (except in the latest models, which do not afford adequate protection). His plane does not have self sealing fuel tanks. His safety devices, radio equipment and instrumentation do not compare with those of American fighters.

All these omissions mean savings in weight which can be translated into performance, but only at the expense of the pilot's safety. Jap pilots are trained to fight and die. This is regarded by American fighting forces. Not alone for humanitarian or sentimental reasons, but because we know one way is more efficient. American pilots are superbly trained, trained to fight and keep on fighting. Thus, vitally important human and material resources are better conserved.

Returning to American types, the North American P-51 *Mustang*, like the P-39 and P-40, was one of the earlier American fighter designs to see active service in the war. It did not come along sufficiently later than the P-39 and P-40, however, to incorporate in its original design applications of new discoveries in fundamental aeronautical research which have been made within the past few years.

The P-51 again is a low wing monoplane with conventional landing gear powered by an Allison liquid cooled engine. Earlier models were equipped with engines rated at 1,050 hp. for takeoff at sea level. It is likely that future models will incorporate a similar powerplant delivering considerably greater horsepower, it is even more likely that this change already has been accomplished. Superficially the *Mustang* resembles the Messerschmitt 109, chiefly because of its square-chipped wing and tail surfaces and angular lines. In some other respects, particularly in the fuselage streamlining, it is akin to the *Spitfires* and *Hurricanes*. The British ordered this fighter in considerable numbers in 1941. From the very first, British reports concerning their all around satisfaction with the performance of this fighter have been at least as enthusiastic as those regarding any other American combat plane.

It is a low and medium altitude fighter. Its engine is equipped with a single-stage blower, which simply means that it was not designed to even attempt to reach high altitudes. The British have placed it in service as an army cooperation plane. For the most part it will be called upon to operate in close connection with ground forces near the battlefields and usually far away from prepared bases. It is ideally suited for this work because of its rugged construction and brilliant performance at lower altitudes. The British have reported that its landing gear has proven exceptionally



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tough and its wide trend, nearly 12 ft., enables it to operate from hastily prepared landing fields or wire mesh landing strips without mishap.

It is not permissible to reveal the maximum speed of the *Mustang*, but the British freely describe it as unquestionably the fastest army cooperation plane in the world. The standard armament of the P-51 consists of two machine guns on top of the fuselage firing through the propeller arc and two machine guns in each wing.

Wings, Tail, Are New Type

Its wings and tail surfaces are of the so-called "laminar flow" section which was developed in the laboratories of the National Advisory Committee for Aeronautics after years of intensive research. The prime requisite for the utilization of these highly efficient sections is smoothness of wing and tail surfaces. Flush riveting and smooth joints between skin panels throughout the plane are means of accomplishing the desired finish.

The newest American fighter in service is the Republic P-47 *Thunderbolt*. This is in many ways a remarkable fighter airplane. It is the first American combat airplane designed since the outbreak of war in 1939 to see action. It is generally conceded to be the world's first fighter airplane to be powered by 2,000-hp. aircooled radial engine. This is the 18-cylinder Pratt & Whitney *Double Wasp*.

The P-47 is a single seat low wing airplane with conventional landing gear. Aside from its husky powerplant, it is distinguished by the fact that it is one of the few fighter planes in the world to be equipped with the famous exhaust-driven turbosupercharger, the same device which was developed and pioneered in the United States and has enabled the famous Boeing *Flying Fortresses* to operate at peak efficiency at extreme altitudes for many years.

Its maximum speed is definitely in excess of 400 mph. It is equipped with six or more 50 calibre machine guns and has a range of operations greatly exceeding that of any other single-engine fighter. Pilots who have flown it and the strategists and engineers who are responsible for its design and construction unhesitatingly rank it as the best single-engine high altitude fighter airplane in production or in action anywhere in the world today.

The design was completed on the P-47 in 1940. Two additional plants are tooling up and getting into production on the same type. Actual reports from AAF officers are understandably lacking in detail, but all are to the good.

This brings us to the twin-engine and multiple place fighters. The Lockheed P-38 *Lightning* is believed to be the only twin engine, single seat fighter plane in action anywhere in the world.

Multiple-Place Fighters

The British Bristol *Beaufighter* is probably the outstanding multiple-place twin engine fighter. The German Messerschmitt 110, an older design, is a three-place twin engine fighter. Planes of this type are really aerial destroyers, capable of roving long distances in search of prey. The combination of high performance, deadly offensive armament and long range enables them to seek out the enemy and engage him in combat at distances far beyond those capable of defense by the small interceptor fighters.

The Lockheed P-38 was first flown in 1939. Piloted by an Army officer, it crossed the United States from the West Coast to the Eastern Seaboard at an average flying speed of 404 mph. An aircraft capable of maintaining that speed for many hours at a time has a maximum speed considerably greater.

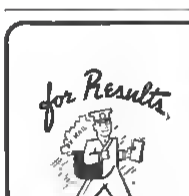
The *Lightning* is at very unusual design. It does not have a fuselage like the conventional aircraft which terminates in the empennage, or tail surfaces. Instead, the two nacelles which house its Allison liquid-cooled, V-type engines, which are similar to those installed in the single-engine fighters, taper into slender booms which support the horizontal tail surfaces at either end and terminate in twin rudders and vertical fins. In place of the fuselage, a large nacelle housing the pilot's cabin and center guns juts well forward out over the leading edge of the wing and terminates at the trailing edge at the center of the wing. The engines are equipped with the very efficient exhaust-driven turbosupercharger, which enable it to perform in the thin air around 40,000 ft.

Uses Tricycle Gear

The P-38, like many other advanced American designs, is equipped with tricycle landing gear. This feature is particularly important for planes of such high performance. It decreases the likelihood of ground looping or nosing over when a pilot is forced to land on a rough field or under other adverse conditions. Its armament consists of multiple cannon and machine guns mounted in the nose of the pilot's nacelle. The *Lightning* got into good quantity production late in 1941 and has been rolling off the assembly lines in increasing numbers ever since. By now, considerable numbers must be in service at the fighting fronts, although few reports have been permitted to be published. Gen. Arnold, however, has stated that the Lockheed P-38's have engaged the Japanese with notable success in the Pacific area.

Complacency Attacked

Americans have no monopoly on brains. Therefore, both allied and enemy nations are creating aircraft, engines and other instruments of war of excellent design and construction. Most of these nations have been learning the lessons of warfare far longer than we have. In some instances, certain foreign products excel ours. As a nation, we are proud that in both war and peace the reverse is generally true. There would be grave danger in kidding ourselves about the superiority of our warplanes if they were not, in fact, superior. They are not above criticism as types or models. Intelligent, constructive criticisms are welcome and should continue. But the inescapable conclusion for all those in possession of the facts is this: American fighter planes, on the whole, are superior to those of our enemies, as our latest types reach the fighting fronts in increasing numbers, the edge of superiority in quality and performance will be increased month by month.



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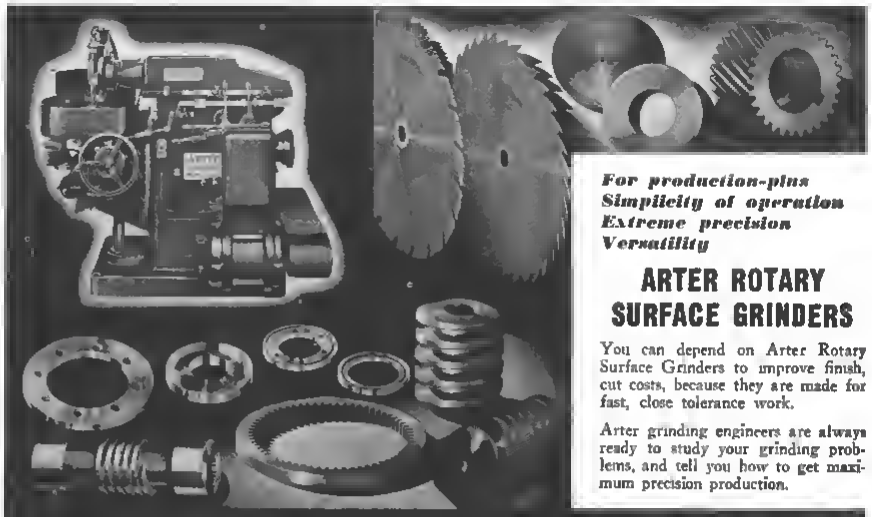
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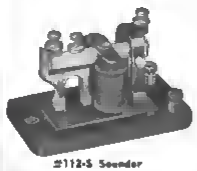
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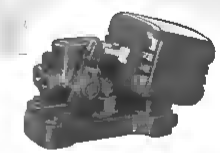
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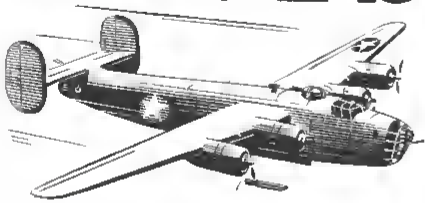
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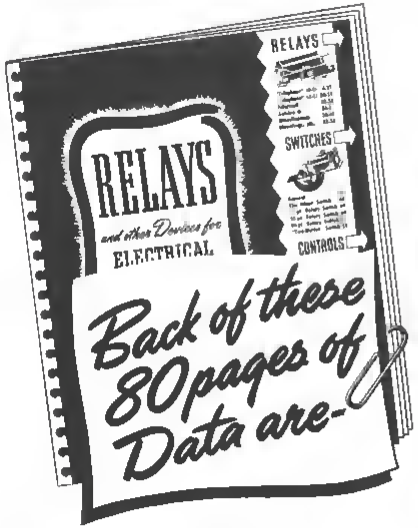
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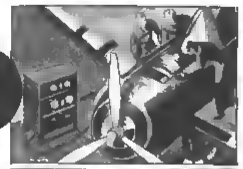
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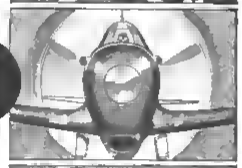
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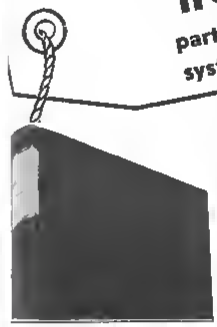
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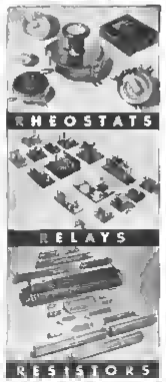
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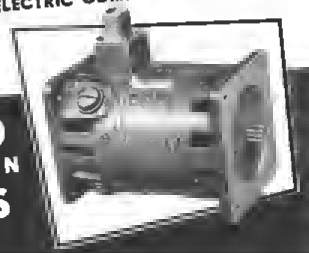
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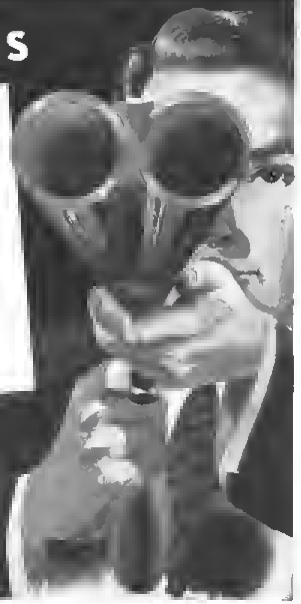
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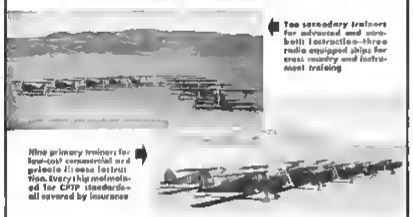
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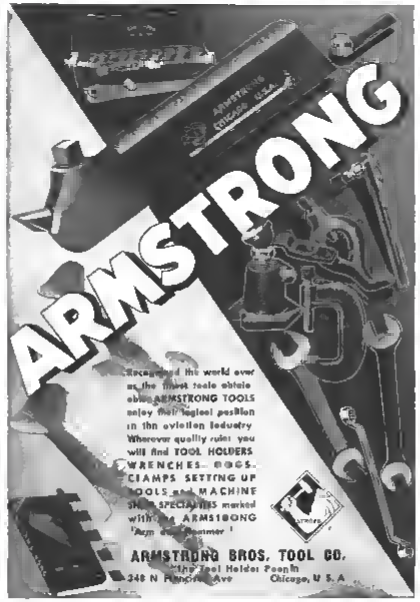
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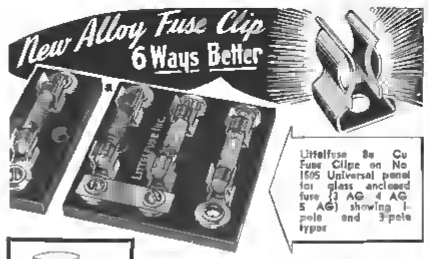
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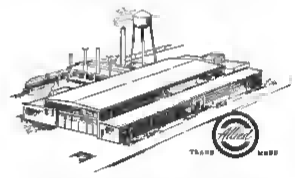
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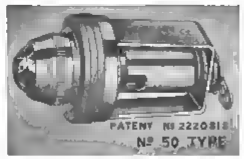
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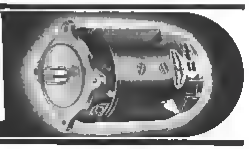
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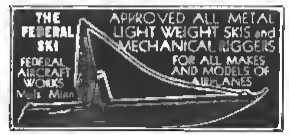
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INDEX

AVIATION "Classified"— Octnbar 1942

Underplayed ads offering only ONE make of plane are grouped under that make Others appear under USED PLANES—General and are numbered and indexed to enable readers to consult finally for the makes of planes offered or other items of interest All other underplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered as referred to by readers and indexed for the reader's convenience in quickly finding ads

ENGINES & PARTS t

EQUIPMENT & PRODUCTS
Classification under Various Headings

Aircraft Batteries 18
Cable Splices 18
Decal Emblems 18
Fighter 18
Instruments 18
Miscellaneous 18
Propeller 18
Skis 18
Soles 18
Soup Dispenser 18
Tires 18
Towels 18
Wiping Cloths 18

SERVICES AND INSTRUCTION
Classification under Various Headings

Instruction Books 10
Repairing 25
Schools and Classes 26
Schools 9 11 14 17 18
21 11 12 3

SPECIAL SERVICES 26

TRADE
Classification under Various Headings

BUSINESS OPPORTUNITIES 29
CONTRACT WORK 8
PROFESSIONAL SERVICES 19
WANTED 13

Equipment & Products

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Equipment & Products

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See Page ← Advertiser ← Number

58 Aero Industries Technical Institute 7
361 Allen Co Inc L B 8
385 American School of Aircraft Instruments 9
364 Becker Aircraft Supply Co 10
366 Boeing School of Aero 11
361 Bucair Mills 12
364 Commerford Decal Co 13
35 Curtiss Wright Technical 14
364 Embry-Riddle Co 15
361 Federal Aircraft Works 16
365 Indiana Technical College 17
361 Jarrod Cable Splicing Eq Co 18
363 Lascaris Allwine & Rommel 19
365 Luscombe School of Aeronautics 20
365 New York School of Aircraft Instruments 21
364 Ori, Kati 22
364 Pan American Navigation Service 23
361 Pax 24
364 Pester's Propeller Service 25
364 Philadelphia Rust Proof Co 26
351 Roosevelt Aviation School 27
361 Rowe Industries Inc 28
363 Simmonds Aerocessories Inc 29
364 Snyder Aircraft Corp 30
10 Spartan School of Aero 31
364 Standard Aircraft Eq Co 32
361 Texaire Inc 33
365 Tri-State College 34
364 United Flying Schools of America Inc 35

Employment

Positions Vacant

EXECUTIVE ASSISTANT wanted Capable man with management experience to act as Assistant to the President Inquiries will be held strictly confidential and should be made to the Office Manager McConnell Aircraft Corporation, St. Louis, Mo SALES MANAGER Must have considerable sales and aircraft experience Please give qualification references and salary desired Inquiries will be held strictly confidential and should be made to the Office Manager McConnell Aircraft Corporation, St Louis, Mo

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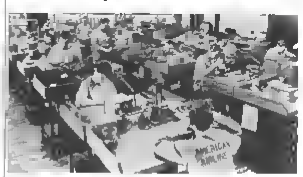
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School Advertising
INDEX . . .
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ADVERTISERS IN THIS ISSUE

Actus Products Corporation 346
Addressograph-Multigraph Corp 21
Adel Precision Products Corp. Insert 61
Aero Industries Technical Institute 58
Aeronca Corporation 156
Aero Tool Company 201
Aircooled Motors Corporation 347
Aircraft Components Inc 194
Aircraft Mechanics Inc. 194
Aircraft Products and Equipment Corp 102
Aircraft Tools 15
Air Maze Corporation 286
Alresearch Mfg Co 64
Alexander Hamilton Institute Inc. 335
Allegheny Ludlum Steel Corporation 59
Allen Co. Inc. L B 361
Allied Aviation Corporation 357
Allied Control Co. Inc 251
Allison Engineering Co 61
Aluminum Co of America 73
American Aeronautic Electric Sales Co 346
American Brass Co The Insert 138-139
American Chain and Cable Co. Inc. 274
American Chemical Paint Co. 281
American Export Lines 312
American Metal Hose Insert 158-159
American Photocopy Equipment Co 136
American Screw Co 136
American Steel and Wire Co 231
Ampco Metals Inc. 336
Armerong Brothers Tool Co 354
Arnall Motor Co 357
Arter Grinding Machine Co. 343
Automatic Alarms Inc 278
Aviation Engineering Inc. 359
Aviation Merchet Place 362 365

B G Corp. The 60
Baker Raulang Co. 228
Bausch & Lomb Optical Co. 304
Beech Aircraft Corp 165
Belden Mfg Co Insert 286
Bell Aircraft Corp. Insert 213
Bendix Aviation Corp 4 60 265
336 Back Cover
Bendix Products 85
Bendix Radio Corp 262
Bendix Stromberg Carburetor 336
Berger Manufacturing 18
Black and Decker Electric Co 31
Black and Decker Mfg Co. 216
Boeing Airplane Co 48
Boeing School of Aeronautics 316
Bonney Forge and Tool Works 196
Booth Fetl Company 334
Boots Aircraft Nur Corp Insert 44
Bowser and Co. Inc S F 333
Breeze Corps. Inc Insert 179
Brewster Aircraft 280
Briggs and Stratton Corp. 264
Bristol Co. The 136
Brocter Mills 361
Cellins Tungaren Mfg. 351
Camfield Mfg Co 306
Canine Fastener Co. Insert 196
Cannon Electric Development Co 321
Carborundum Company The 319
Cardox Corp 285
Carnegie-Illinois Steel Corp 251
Carpenter Steel Co. The 348
Cessna Co of Kansas 308
Castle Films Inc 311
Celanese Celluloid Corp 71
Celotex Corp The 173
Central Screw Co 136
Cessna Aircraft Co 264
Challenge Machinery Co. The 172
Chamberslurg Engineering Co. 76
Champion Aviation Products Co. 361
Chandler Products Corp 136
Cherry River Co 319
Chicago Metal Hose 309
Chicago Pneumatic Tool Co. 226
Chicago Wheel and Mfg Co. 313
Clarke Aero Hydraulics Inc 361
Cleveland Pneumatic Tool Co The 31
Climax Molybdenum Co 183
Columbia Steel Co 231
Consolidated Aircraft Corp 76
Consolidated Engineering Corp 76
Consolidated Equipment Inc 59
Continental Can Co 193
Continental Motors Inc 243
Coormental Screw Corp 135
Corbin Screw Corp The 136
Crescent Co The 182
Cuno Engineering Corp 152-153
Curtiss Aeroplane Co Insert 43-177 214
Curtiss Engineering Machinery 306
Curtiss Propeller Co Insert 43-177 214
Curtiss Wright Corp Insert 43-177 214
Curtiss Wright Technical Institute 34
Cutler-Hammer Inc. 27
Darnell Corp Ltd. 165
Davison Chemical Corp. The 35
Deere Mfg Co The 347
De Jur-Amsco Corp 366
Dix Mfg Co 162
Dole Valve Co The 337
Dow Chemical Co The Third Cover
Drake Mfg Co 360

Driver Co. Wilbur B 355
Dumore Co. The 218-220
Eclipse Aviation Back Cover
Economy Engineering Co 344
Elastic Stop Nut Corp. 162
Electric Auto Lite Co. The 73
Elwell-Parker Electric Co. The 356
Emerson Electric Mfg Co The 49
Faber Inc. A. W 301
Fafnir Bearing Co. The 8
Farnham Mfg Co. 246
Farquher Co. Inc A B 72
Federal Aircraft Works 361
Federal Bearings Co. Inc The 26
Fenwal Inc 356
Fleerwinge Inc 274-273
Flex O Tube Co. The 36
Peoria Bros Gear and Mechine Corp 237
Formica Insulation Co 47
Galland-Henning Mfg Co 345
Gardner Denver Co. 74
General Aniline and Film Corp 33
General Controls 226
General Electric Co. 16-42-236 352
General Tire and Rubber Co. The 279
Globe Steel Tubes Co 68
Goodrich Co The B F Insert 139-146
Goodyear Tire and Rubber Co Inc.
The 134 135
Govro-Nelson Co The 356
Grinnell Co. Inc. 285
Grumman Aircraft Engineering Co 308
Grob Brothers 303
Guardian Electric 77
Guiberson Diesel Engine Co. 66
Gull Oil Corp 8
Guth Co. The Edwin F 151
Hanson Mfg Co. 353
Hartzell Propeller Co 136
Harvill Corp 34
Hassall Inc. John 296
Hayes Industries Inc 54
Hecker A. W 46
Heward Aircraft Corp 33
Hubbell Inc Hervey 359
Hunter Electro-copyist, Inc 358
Hycar Chemical Co 22
Hyland Machine Co 235
Independent Pneumatic Tool Co 257
International Flare-Signal 357
International Nickel Co. The 265
International Screw Co. 136
International Telephone & Tel Corp 266
Jacobs Aircraft Engine Co. 264
Jarnel Cable Splicing Equipment Co 361
Jefferson-Travis Radio Mfg Corp 227
Joyce Aviation Corp Insert 286
Kelley-Keert Mfg. Co The 146
Kenfail and Esser Co 245
Kaffe & Co Walter 173
Kilgore Mfg Co 357
Kimmer Mfg Co The 289
Klaxe Mfg Co 26-28
Koh I-Noor Pencil Co. Inc 336
Kollsmen Instrument Div of Square
D Co 126
Lamson & Sessions Co. The 136
Leland Electric Co. The 355
Lincoln Engineering Co 323
Lilly Vernich Co 332
Lirtellnsa Inc 357
Lockheed Aircraft Corp 43
Lone Scoreboard Co. The 236
Lycoming Mfg Corp 12
Lyon Metal Products Inc. 198-191
Mac Dermid Inc. 263
Mallory and Co. P R 45
Merlin Rockwell Corp. Insert 267
Mertindale Electric Co 336
Marvin Co. The Glenn L 69
McDonnell Aircraft Corp 11
McGraw Hill Book Company 344-353
McGraw Hill Publishing Company 340-341
Micro Switch Corp. 245
Mid-West Abrasive Co 317
Milburn Co. The Alexander 338
Miller Co. The 256
Miller Rubber Industrial Products 262
Mishlock Mfg Co 336
Muskegon Piston Ring Co 17
National Bronze & Aluminum Foundry
Co The 166
National Screw and Mfg Co The 136
National Tube Co. 251
New England Screw Co 136 143
Niagara Machine and Tool Works 343
Nicholson File Co. 41
Norgren Co C A 325
Norma Hoffmann Bearings Corp 63
North American Aviation Inc 39
Oster Mfg Co. John 302
Ozalid Products 63
Pacific Airmee Corp 272
Packard Electric 314
Parker Co. The Charles 156
Parker Kalon Corp 65-138
Pawtuchal Screw Co. 136
Pax 361
Peck Spring Co. The 343
Penn Metal Corp of Penna 144
Perkin-Elmer Corp The 56

Phenil Mfg. Co 136
Phillips Screw Mfg Co 139
Pioneer Instrument 6
Pioneer Parachute Co. Inc. 361
Piper Aircraft Corp. 7
Plastics Institute 356
Portland Cement Association 327
Potter, Inc 367
Pulsen and Nardin, Inc 292
Pratt and Whitney Aircraft Front Cover
Prince Steel Co. The 180
Pump Engineering Service Corp Insert 231
Remington Rand Inc 365
Republic Aviation Corp 202
Republic Steel Corp 6-181-274
Resner Mfg Co 276
Ridge Tool Co. The 166
Rohm and Haas Co. 264
Rohr Aircraft Corp 287
Roller Bearing Co of America 32
Romec Pump Co 130
Roosevelt Aviation School 331
Rowe Industries, Inc 361
Russell Birdsall and Ward Bolt and
Nut Co 136
Ryan Aeronautical Co 216
Ryerson and Son Inc Joseph T 147
Schatz Mfg Co. The 255
Schroeder's Son A 340
Scovill Mfg Co. 136
Sealed Power Corp. 23
Seosenich Brothers 226
Shekegraef Inc. 13-136
Sheffield Corp. The 146
Signal Electric Mfg Co 344
Sinclair Refining Co. Inc 252
Snap On Tools Corp 16
Solar Aircraft Co. 347
Smith Bend Lathe Works 14
Southbugton Hardware Mfg Co. 138
Southern Engineering Co Inc 303
Spartan Aircraft Co 37
Spartan School of Aeronautics 16
Sperry Gyroscope Co., Inc 38
Spencer Thermostat Co 244
Spriensch Tool and Mfg. Co. 341
Senere D Co Kollsmon Inst Div 129
Stenltier Inc. I S 285
Steudard Aircraft Products Inc 53
Stanford Pressed Steel Co. 30
Sterling Tool Products Co 355
Stewart Warner Corp 260
Sumner Products Co 85
Swiftik Parachnic Co 232
Synthene Corp 277

Tannaware Works The 82
Taylor Fibre Co. 29
Tennessee Coal Iron and Railroad Co 251
Tenney Engineering Inc 87
Terry Co George A 326
Texas Company The 219
Thomas and Betts Co. The 57
Thompson Prodnere Inc. Second Cover
Tlosken Roller Bearing Co The 106
Tinnerman Products Inc 145
Titanine Inc 361
Trafflex Metal Hose Co 234
Terrungan Co The Insert 62
Tuzex Products Inc 316
United Aircraft Corp Front Cover & 246
United Flying Schools of America 354
United States Electrreel Tool Co The 322
United States Rubber Co 32
United States Steel Corp Subsidiaries 631
United States Steel Export Co 251
United States War Bonds and Stamps 336
United States Hammered Piston Ring
Co. Inc 358
Velennne and Co. Inc 164
Vard Inc 206
Veeder Root Inc 226
Vickers Inc 133
Vokes, Ltd. 242
Vultee Aircraft Inc Insert 163
Vought Sikorsky Aircraft 246
Wellsee & Tiernen Products Inc 64
Ward Leonard Electric Co. 334
Waugh Equipment Co 67
Weatherhead Co The Insert 276
Weldee Roberts Rubber Co 346
Wellington Seare Co 359
Wellmen Bronze and Aluminum Co 262
Westneghouse Electric and Mfg Co 24-25
Weston Electrleel Inerument Corp 320
Where to Buy 361
Whitehead Stamping Co 361
Whiting Corp 180
Whitney Chain and Mfg Co., The 346
Whitney Screw Co 136
Wiley and Sons Inc John 143-148-315
Wilson Co The H A 324
Wilson Welder & Metal Co Inc 224-225
Williams & Co J H 56
Whitek Mfg Co 171
Wolls & Mixon Mfg Co The 221
Worthington Mower Co 222 223
Wright Aeronautical Corp Insert 43-177
214
Wyman Gordon 357
Young Radiator Co. 168

★ ★ ★

SCHOOLS

Aero Industries Technical Institute 58
Aeronca School of Aircraft Instrumentr 356
Boeing School of Aero 316
Curtiss Wright Technical Institute 34
Indiana Technical College 365
Lincoln School of Aeronautics 365
New York School of Aircraft Instrumentr 356
Roosevelt Aviation School 354
Spartan School of Aero 16
Tri State College 360
United Flying School of Aero Inc 354

AVIATION'S MARKET PLACE
(CLASSIFIED ADVERTISING)

BOOKS 364

EMPLOYMENT (Position Wanted and Vacant) 362
EQUIPMENT & PRODUCTS 362
FOR SALE (Used Planes) 362 363
PROFESSIONAL SERVICES 363
INDEX of Planes, Engines and Parts For Sale 362

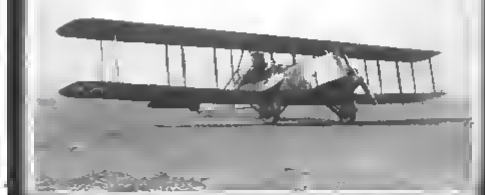
(CLASSIFIED DISPLAY ADVERTISING)

Becker Aircraft Supply Co 354
Commercial Metal Co 353
Emery Airfield Co 364
Lancaster Allwine & Rom mel 354
Orl Kerl 354
Pan American Navigation Service 364
Parker Propeller Service 364
Ph Indestructo Rivet Proof Co 354
Simmonds Aerocessories Inc. 362
Snyder Aircraft Corp 361
Stanford Aircraft Equipment Co 361

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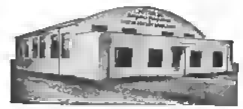
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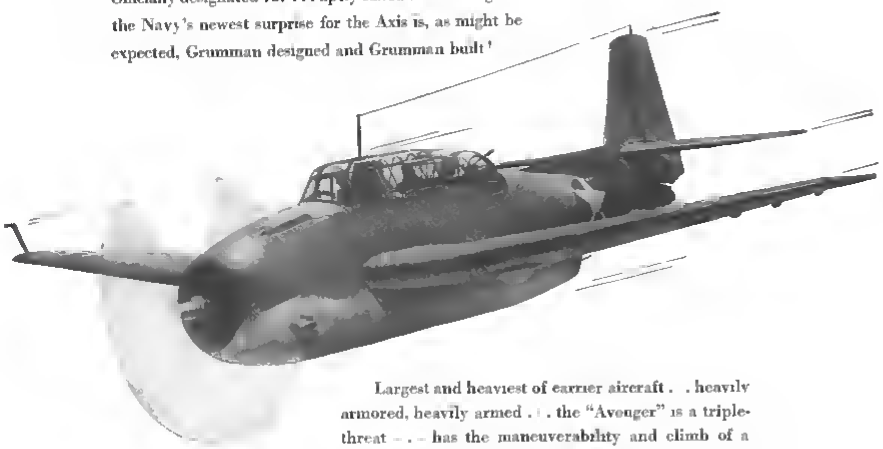
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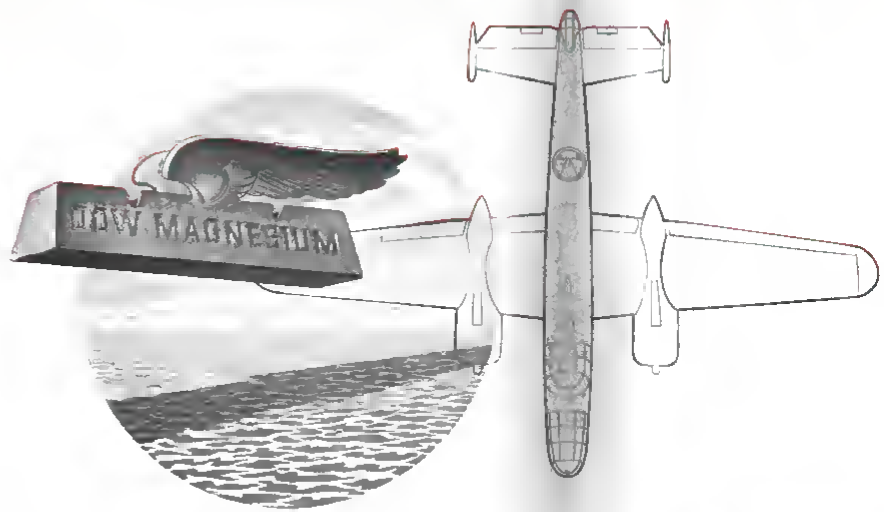
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